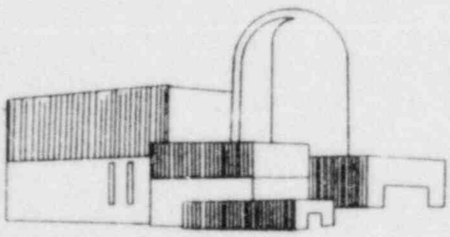
DETAILED CONTROL ROOM DESIGN REVIEW

PROGRAM PLAN



CLINTON POWER STATION

ILLINOIS POWER COMPANY

APPROVAL

Recommended Approval: [signature]
Power Plant Manager

Recommended Approval: J S Spencer for HR Victor 9/27/84
Manager - NSED

Approved: [signature]
Vice President

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REVISION LOG

Revision No.	Date	Description	Pages Affected
PREL. A	7/30/84	Initial Issue	--
PREL. B	8/24/84	Second Issue	General
PREL. C	9/05/84	Third Issue	General
REV. 0	9/19/84	NRC Issue	General

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ACRONYMS AND ABBREVIATIONS
LISTED ALPHABETICALLY BY ACRONYMS

ADS	Automatic Depressurization System
APRM	Average Power Range Monitor
ARM	Area Radiation Monitor
ATAF	Above Top of Active Fuel
BOP	Balance of Plant
BWR	Boiling Water Reactor
BWROG	Boiling Water Reactor Owners Group
CL	Checklist
CPS	Clinton Power Station
CR	Control Room
CRD	Control Rod Drive
CRI	Control Room Inventory
CRS	Control Room Survey
CRVIS	Containment and Reactor Vessel Isolation System
DBMS	Data Base Management System
DCRDR	Detailed Control Room Design Review
DW	Drywell
EOP	Emergency Operating Procedure
EOP V&V	EOP Verification and Validation
EPRI	Electric Power Research Institute
ERCIP	Emergency Response Capability Implementation Plan
FSAR	Final Safety Analysis Report
GE	General Electric
HEDs	Human Engineering Discrepancies
HEOs	Human Engineering Observations
HPCS	High Pressure Core Spray
HVAC	Heating, Ventilation and Air Conditioning
INPO	Institute of Nuclear Power Operations
IRM	Intermediate Range Monitor
LER	Licensee Event Report

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LPCI	Low Pressure Coolant Injection
LPCS	Low Pressure Core Spray
LPRM	Local Power Range Monitor
LRW	Liquid Radwaste
LVL	Level
MSIV	Main Steam Isolation Valve
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
OER	Operating Experience Review
PC	Primary Containment
PDA	Preliminary Design Assessment
P&ID	Piping and Instrumentation Drawing
PRM	Process Radiation Monitor
PWR	Power
RBM	Rod Block Monitor
RCIC	Reactor Core Isolation Cooling
RF	Refueling
RHR	Residual Heat Removal
RPC	Rod Pattern Control
RPS	Reactor Protection System
RPV	Reactor Pressure Vessel
RWM	Rod Worth Minimizer
SBGT	Standby Gas Treatment
SFTA	System Function and Task Analysis
SLCS	Standby Liquid Control System
SOE	Selected Operational Event
SOER	Significant Operating Experience Report
SP	Suppression Pool
SPDS	Safety Parameter Display System
SRM	Startup Range Monitor
SRV	Safety Relief Valve
TAF	Top of Active Fuel
TBCCW	Turbine Building Closed Cooling Water
WS	Service Water

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ACRONYMS AND ABBREVIATIONS
LISTED ALPHABETICALLY BY DEFINITIONS

Above Top of Active Fuel	ATAF
Area Radiation Monitor	ARM
Automatic Depressurization System	ADS
Average Power Range Monitor	APRM
Balance of Plant	BOP
Boiling Water Reactor	BWR
Boiling Water Reactor Owners Group	BWROG
Checklist	CL
Clinton Power Station	CPS
Containment and Reactor Vessel Isolation System	CRVIS
Control Rod Drive	CRD
Control Room	CR
Control Room Inventory	CRI
Control Room Survey	CRS
Data Base Management System	DBMS
Detailed Control Room Design Review	DCRDR
Drywell	DW
Electric Power Research Institute	EPRI
Emergency Operating Procedure	EOP
Emergency Response Capability Implementation Plan	ERCIP
EOP Verification and Validation	EOP V&V
Final Safety Analysis Report	FSAR
General Electric	GE
Heating, Ventilation and Air Conditioning	HVAC
High Pressure Core Spray	HPCS
Human Engineering Discrepancies	HEDs
Human Engineering Observation	HEOs
Institute of Nuclear Power Operations	INPO
Intermediate Range Monitor	IRM

Level	LVL
Licensee Event Report	LER
Liquid Radwaste	LRW
Local Power Range Monitor	LPRM
Low Pressure Coolant Injection	LPCI
Low Pressure Core Spray	LPCS
Main Steam Isolation Valve	MSIV
Nuclear Regulatory Commission	NRC
Nuclear Steam Supply System	NSSS
Operating Experience Review	OER
Piping and Instrumentation Drawing	P&ID
Power	PWR
Preliminary Design Assessment	PDA
Primary Containment	PC
Process Radiation Monitor	PRM
Reactor Core Isolation Cooling	RCIC
Reactor Pressure Vessel	RPV
Reactor Protection System	RPS
Refueling	RF
Rod Block Monitor	RBM
Rod Pattern Control	RPC
Rod Worth Minimizer	RWM
Safety Parameter Display System	SPDS
Safety Relief Valve	SRV
Selected Operational Event	SOE
Service Water	WS
Significant Operating Experience Report	SOER
Standby Gas Treatment	SBGT
Standby Liquid Control System	SLCS
Startup Range Monitor	SRM
Suppression Pool	SP
System Function and Task Analysis	SFTA
Top of Active Fuel	TAF
Turbine Building Closed Cooling Water	TBCCW

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1.0 INTRODUCTION

1.1 GENERAL COMMENTS

This report describes the Illinois Power Company's plan to perform a Detailed Control Room Design Review (DCRDR) of its Clinton Power Station. The purpose of this DCRDR is to identify and implement control room design improvements that provide assurance for meeting plant safety and availability objectives.

The need for control room design reviews has been well documented by the NRC as a result of the investigations of the Three Mile Island accident. The principal areas of concern identified included: non-compliance of control room facilities with human factors principles, deficiencies in providing operator presented information and inadequate operating procedures.

The need for this DCRDR is required by the NRC as follows:

- Item I.D.1, "Control Room Design Reviews," of the NRC Action Plan (NUREG-0660) developed as a result of the TMI-2 accident states that the operating licensees and applicants for operating licenses will be required to perform a Detailed Control Room Design Review (DCRDR) to identify and correct design discrepancies.

- Supplement 1 to NUREG-0737, dated December 17, 1982, further clarified the DCRDR requirement in NUREG-0660. As a result of Supplement 1 to NUREG-0737, each applicant or licensee is required to conduct their DCRDR on a schedule negotiated with the NRC.

The Clinton Power Station plan and schedule for conducting the DCRDR was submitted to the NRC in the following letters:

- o Letter 0970-L dated April 13, 1983 from D. P. Hall to A. Schwencer," Clinton Power Station Unit #1, Supplement to NUREG-0737: Requirements for Emergency Response Capability."

- o Letter U-0647 dated July 5, 1983 from G. E. Wuller to A. Schwencer," Clinton Power Station Unit #1, Emergency Response Capability Implementation Schedule."

The NRC staff has developed human engineering guidelines to assist each licensee/applicant in the performance of the DCRDR as delineated in NUREG-0700.

This DCRDR will be conducted to include the NUREG-0700 four phases, which are:

1. Planning
2. Review
3. Assessment and Implementation, and
4. Reporting.

The Illinois Power Company will utilize NUREG-0801 October 1981, "Draft Evaluation Criteria for Detailed Control Room Design Review," which provides the criteria that it expects the NRC to use for evaluating the above phases.

This program plan will describe how the following elements required by Supplement 1 to NUREG-0737 will be accomplished:

1. Establishment of a qualified multidisciplinary review team.

2. Function and task analyses that has been used as the basis for developing generic BWR Emergency Procedure Guidelines and Plant-specific Emergency Operating Procedures to identify control room operator tasks and information and control requirements during emergency operations.

3. A comparison of display and control requirements with a control room inventory.

4. A control room survey to identify deviations from accepted human factors principles.

5. Assessment of human engineering discrepancies (HEDs) to determine which HEDs may be significant and should be corrected.

6. Selection of design improvements that will correct HEDs.

7. Verification that selected design improvements will provide the necessary correction.

8. Verification that improvements will not introduce new HEDs.

9. Coordination of control room improvements with SPDS, instrumentation for Regulatory Guide 1.97 (Revision 3) and Emergency Procedure Guidelines, operator training and upgrading Emergency Operating Procedures to enhance the operator's ability to comprehend plant conditions and cope with emergencies.

In addition the program plan will define how the System Function and Task Analysis with the associated verification and validation will be integrated with the verification and validation of the Emergency Operating Procedures.

1.2 OBJECTIVES

The Illinois Power Company intends to complete this review in a timely and cost effective manner to:

1. Determine whether system status information, control capabilities, feedback and analytical aids necessary for control room operators to accomplish their functions in an effective, safe and reliable manner are provided in the control room.

2. Identify characteristics of the existing control room instrumentation, controls, other equipment and physical arrangements that may significantly impact operator performance.

3. Analyze and evaluate potential problems that identified this review.

4. Define and implement a plan of action that applies required human factors principles to enhance operator effectiveness. Particular emphasis will be placed on improvements affecting control room design and operator performance under normal or emergency conditions.

5. Integrate the DCRDR with other areas requiring the application of human factors principles identified in the Illinois Power Company's response to Supplement 1 to NUREG-0737.

6. Incorporate the results of the review of the main control room during the Preliminary Design Assessment conducted in 1981.

7. Review the main control room systems and items listed in the Clinton Power Station Safety Evaluation Report NUREG-0853 (Chapter 18) that were not available during the Preliminary Design Assessment.

1.3 PLANT DESCRIPTION

The Clinton Power Station Unit 1 is currently under construction in Harp Township, Dewitt County on a site approximately six miles east of the city of Clinton in east-central Illinois (see Figure 1-1). The unit core thermal power is rated at 2894 MW(t) (100% steam flow). The unit is designed to operate at a gross electrical power output of approximately 985 MW(e).

The nuclear steam supply system is a General Electric BWR/6 boiling water reactor. The containment system employs the drywell/pressure-suppression features of the BWR-Mark III containment concept. The basic power conversion unit is a General Electric turbine generator, 1800 rpm, tandem compound, four-flow, reheat steam turbine with a gross electrical output of 984,866 kW. Commercial operation of Unit 1 is scheduled for late 1986.

1.4 DEFINITION OF CONTROL ROOM

The control room is defined as the following consoles, bench boards and panels including the SPDS displays which are used by the operators for normal and emergency plant operations:

CONSOLES

P679 Shift Supervisor's Console
P680 NUCLENET

FRONT PANELS

P601 Nuclear Steam Supply System (NSSS)
P877 Balance of Plant (BOP)
P801 BOP
P800 BOP
P870 BOP

BACK PANELS

P678 Standby Information Panel
P864 Area and Process Radiation Monitoring Display

REMOTE SHUTDOWN PANEL

C61-P001 (not in the main control room)

The DCRDR will extend to other Man/Machine interfaces identified as a result of the analysis of selected events during the System Function and Task Analysis (SFTA) activity. Figure 1-2 illustrates the layout of the main control room.

1.5 PREVIOUS HUMAN ENGINEERING REVIEWS

A Preliminary Design Assessment (PDA) of the main control room was conducted by General Physics Corporation in 1981.

The NRC Control Room Design Review/Audit Report and the Clinton Power Station response to the findings are addressed in NRC letter from H. Bernard to G. Wuller dated July 16, 1982, "Status Report of the Clinton Power Station Unit 1 Control Room Design Review."

1.6 CONTROL ROOM STATUS

The main control room modifications to correct the findings noted in the NRC "Control Room Design Review/Audit Report, dated 12/11/81" are presently being implemented and are scheduled to be completed early in 1985. Instrumentation in the main control room is being installed to meet the requirements of Regulatory Guide 1.97 (Revision 3) and Emergency Procedure Guidelines. This instrumentation is scheduled to be operational late in 1985.

1.7 FULL-SCALE MOCK-UP

A full-scale mock-up of the defined control room will be constructed. Full-scale color photographs will be assembled on boards representing each control room panel. These panels will be assembled to resemble the control room consoles and control panels. Clear plastic covers will be provided to facilitate the corrective phase studies.

1.8 SIMULATOR

A full-scale plant-referenced simulator is being manufactured by the Singer Link Company. It is scheduled for delivery to the Clinton Power Station training center late in 1984. The simulator will comply with ANSI/ANS-3.5-1981. This facility will likely be used in the DCRDR.

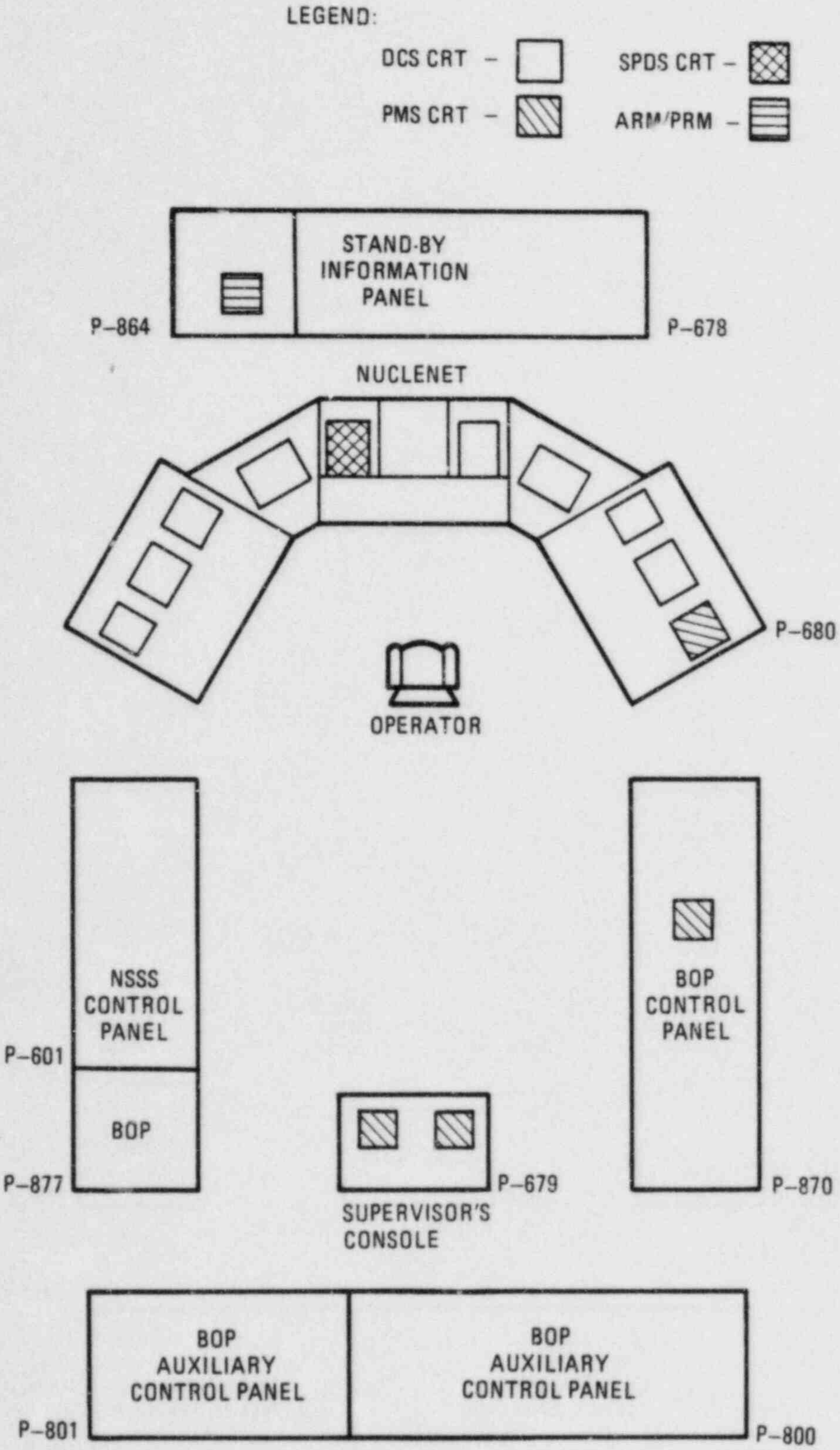

Figure 1-2. Layout of Main Control Room

2.0 MANAGEMENT STAFFING AND PLANNING

2.1 GENERAL COMMENTS

The DCRDR will be conducted to meet the requirements of NUREG-0737 Supplement 1, using the guidelines as recommended in NUREG-0700. It will consider the integration of human factors requirements that may affect control room design. The overview of the DCRDR processes is shown in Figure 2-1 which is a copy of Exhibit 3-1 of NUREG-0700. The DCRDR will emphasize the following items noted in NUREG-0737, item I.D.1 as follows:

"(1) The adequacy of information presented to the operator to reflect plant status for normal conditions, anticipated operational occurrences and accident conditions;

(2) The groupings of displays and the layout of panels;

(3) Improvements in the safety monitoring and human factors enhancement of controls and control displays;

(4) The communications from the control room to points outside the control room, such as the onsite Technical Support Center, Remote Shutdown Panel, offsite telephone lines and to other areas within the plant for normal and emergency operation;

(5) The use of direct rather than derived signals for the presentation of process and safety information to the operator;

(6) The operability of the plant from the control room with multiple failures of non-safety grade and nonseismic systems;

(7) The adequacy of operator training and operating procedures with respect to limitations of instrumentation displays in the control room;

(8) The categorization of alarms, with unique definition of safety alarms; and

(9) The physical location of the shift supervisor's office adjacent to or within the control room complex."

2.2 PLANNING

The planning phase covers relevant actions completed to date or planned as noted herein.

The Emergency Response Capability Implementation Plan (ERCIP) was written to coordinate the completion of integrated activities in Supplement 1 to NUREG-0737. The ERCIP integrates the design of the SPDS, the design of instrument displays based on Regulatory Guide 1.97 (Revision 3) and the Emergency Procedure Guidelines, the Detailed Control Room Design Review, the upgrading of Emergency Operating Procedures and operator training for the purpose of enhancing the operator's ability to comprehend plant conditions and cope with emergencies.

2.3 MANAGEMENT AND STAFFING

The Vice President has designated the ERCIP Project Manager to guide, monitor and implement the activities for Supplement 1 to NUREG-0737. Program Managers have been designated for each activity and they report to the ERCIP Project Manager (see Figure 2-2).

The DCRDR Program Manager has designated a Principal Investigator and has established a DCRDR Review Team. The ERCIP provides the management organization as recommended in NUREG-0700 as follows:

- o Assure proper relationship and awareness between this project and other NUREG-0660 efforts.
- o Define objectives.
- o Formulate the task structures for the program (see Figure 2-3).
- o Define the review team activities.
- o Approve detailed program plan.
- o Provide resources required to carry out the program plan.
- o Identify and assure that plant operational constraints and project requirements are properly coordinated.
- o Monitor DCRDR progress.
- o Review and approve the assessment process.
- o Review and approve control room improvement recommendations.
- o Establish and initiate the control room improvement program.

A senior human factors specialist will provide human factors assistance to Illinois Power Company management. Figure 2-2 shows the functional organization for the ERCIP. Table 2-1 shows the composition of the DCRDR program organization that has been established to address the emergency response activities in Supplement 1 to NUREG-0737.

To facilitate this review, the Illinois Power Company project management authorized the construction of a full-scale realistic mock-up of the control room panels, in addition to the simulator for an extensive review by human factors and systems specialists.

The Design Review Team has the responsibility for the technical scope of the DCRDR. Assignments of team members to the various task groups are based on the specific needs for each task. Table 2-1 shows the assignments of the team members. This table indicates the strong participation of human factors specialists in all major tasks and participation of the key Design Review Team members in most activities. The principal investigator can arrange for additional engineering and operations assistance on an "as-needed" basis.

The qualifications of the Design Review Team members are consistent with the guidelines of NUREG-0801. The qualification of its consultant's (Torrey Pines Technology) members have been reviewed in a variety of past DCRDR program plans and have been favorably commented on by the NRC.

Resumes of key Design Review Team members are attached as Appendix A.

The overall schedule for the DCRDR program is shown on Figure 2-4.

The level of effort planned for the DCRDR is shown on Table 2-2.

TABLE 2-1

DCRDR DESIGN REVIEW TEAM MEMBERS
AND ASSOCIATED TASK ASSIGNMENTS

Program Manager

R. P. Bichel

Principal Investigator

M. J. Hollinden
P. J. Telthorst (Alternate)

Project Engineer
Sr. Human Factors Specialist

S. F. Luna

Planning

S. F. Luna
R. Sabeh
R. P. Bichel
M. A. Krause*
M. J. Hollinden
P. J. Telthorst

System Function and Task Analysis (EOP & DCRDR)

W. R. Arnold
E. P. Gagnon
S. F. Luna
R. C. Potter
F. P. Scaletta
T. A. Sgammato
D. M. Antonelli
J. M. Hall
M. J. Hollinden
M. A. Krause*
P. J. Telthorst

Operating Experience Review

S. F. Luna
R. Sabeh
D. M. Antonelli
R. P. Bichel
M. J. Hollinden

Verification of Task Capabilities and EOPs

W. R. Arnold
E. P. Gagnon
F. Scaletta
R. Sabeh
D. M. Antonelli
J. M. Hall
M. A. Krause*
J. R. Patten
E. A. Schweitzer

Control Room Survey

W. R. Arnold
E. P. Gagnon
S. F. Luna
R. Sabeh
W. Welch
D. M. Antonelli
R. P. Bichel
M. J. Hollinden

Validation of Control Room Functions and EOPs

E. P. Gagnon
R. Sabeh
S. F. Luna
D. M. Antonelli
J. M. Hall
M. A. Krause*
J. R. Patten

Control Room Inventory

E. P. Gagnon
F. P. Scaletta
T. A. Sgammato
R. P. Bichel
M. J. Hollinden

*also a member of the EOP upgrade program.

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TABLE 2-1 (cont.)

DCRDR DESIGN REVIEW TEAM MEMBERS AND ASSOCIATED TASK ASSIGNMENTS

Assessments/and Implementation		Documentation	
W. R. Arnold	D. M. Antonelli	E. P. Gagnon	M. J. Holliden
E. P. Gagnon	R. P. Bichel	S. F. Luna	P. J. Telthorst
S. F. Luna	M. J. Hollinden		
R. Sabeh	M. A. Krause*		
	J. P. O'Brien		
	T. L. Riley		
	P. J. Telthorst		

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Table 2-2

LEVEL OF EFFORT (MAN-HOURS)
OF VARIOUS DISCIPLINE GROUPS
IN PERFORMING THE DCRDR FOR
CLINTON POWER STATION

DCRDR PHASE/TASK	HUMAN FACTORS ENGINEERS	REACTOR OPERATORS	I&C ENGINEERS	NUCLEAR SYSTEMS ENGINEERS
Planning	220		100	120
Review:				
Operating Experience Review	220	140	40	40
Inventory			200	200
Control Room Survey	300	120	40	
Task Analysis	80	40	300	400
Verification and Validation	80	120	100	400
Assessments	200	80	200	40
Correction/Effectiveness	120	80	80	80
Documentation	120		100	80
Project Meetings	80	40	100	80

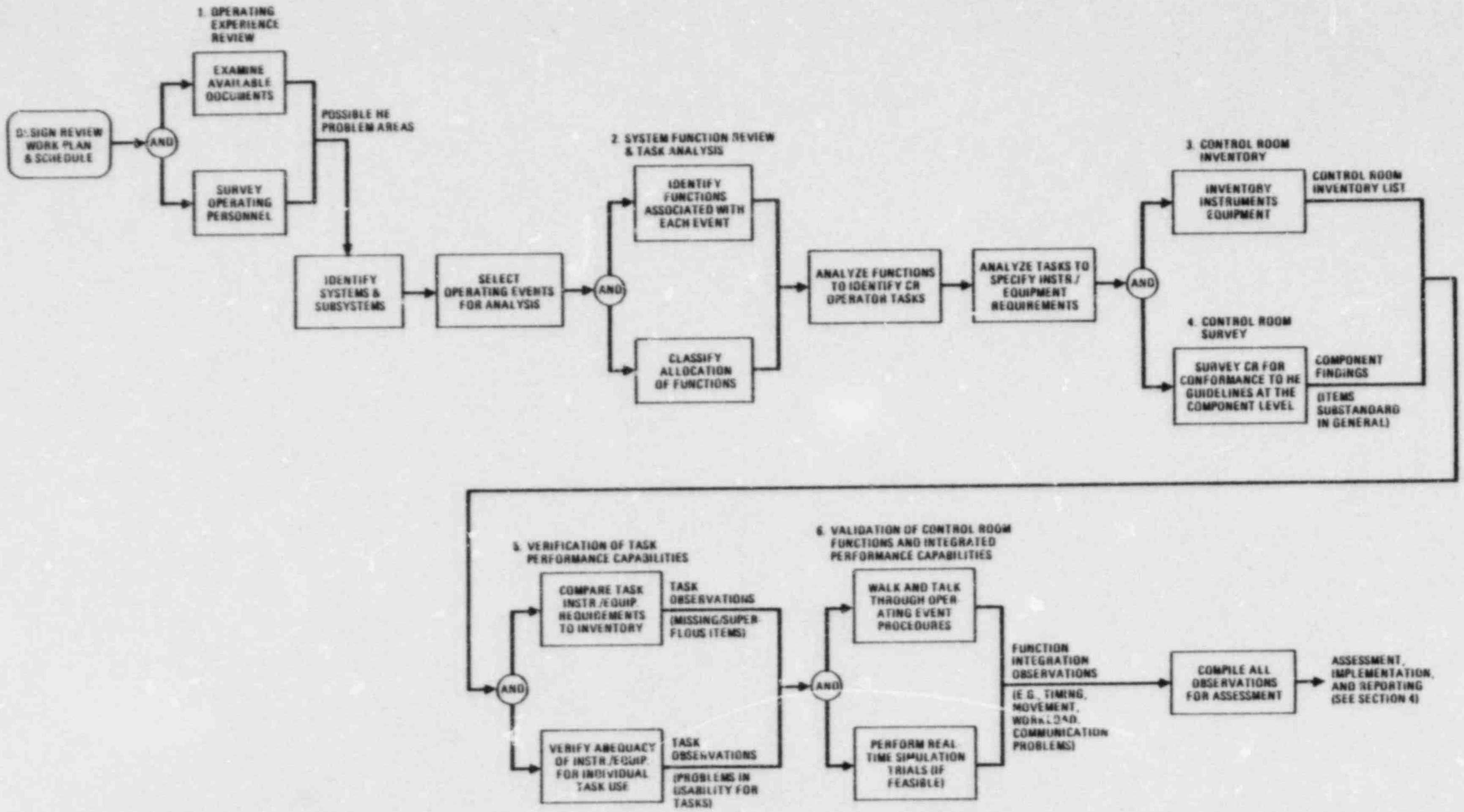


Figure 2-1. Overview of DCRDR Process

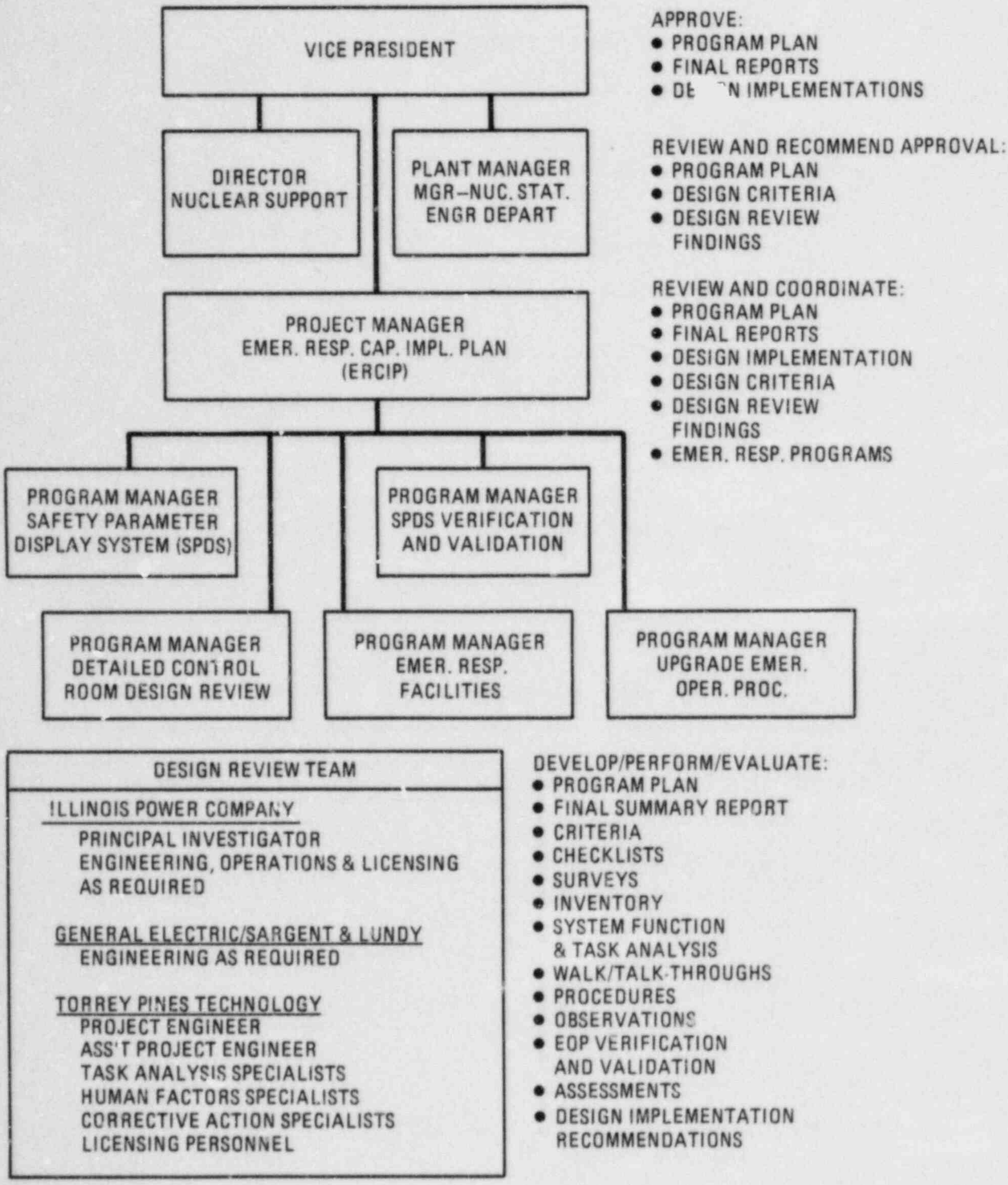


Figure 2-2. Overall ERCIP Organization

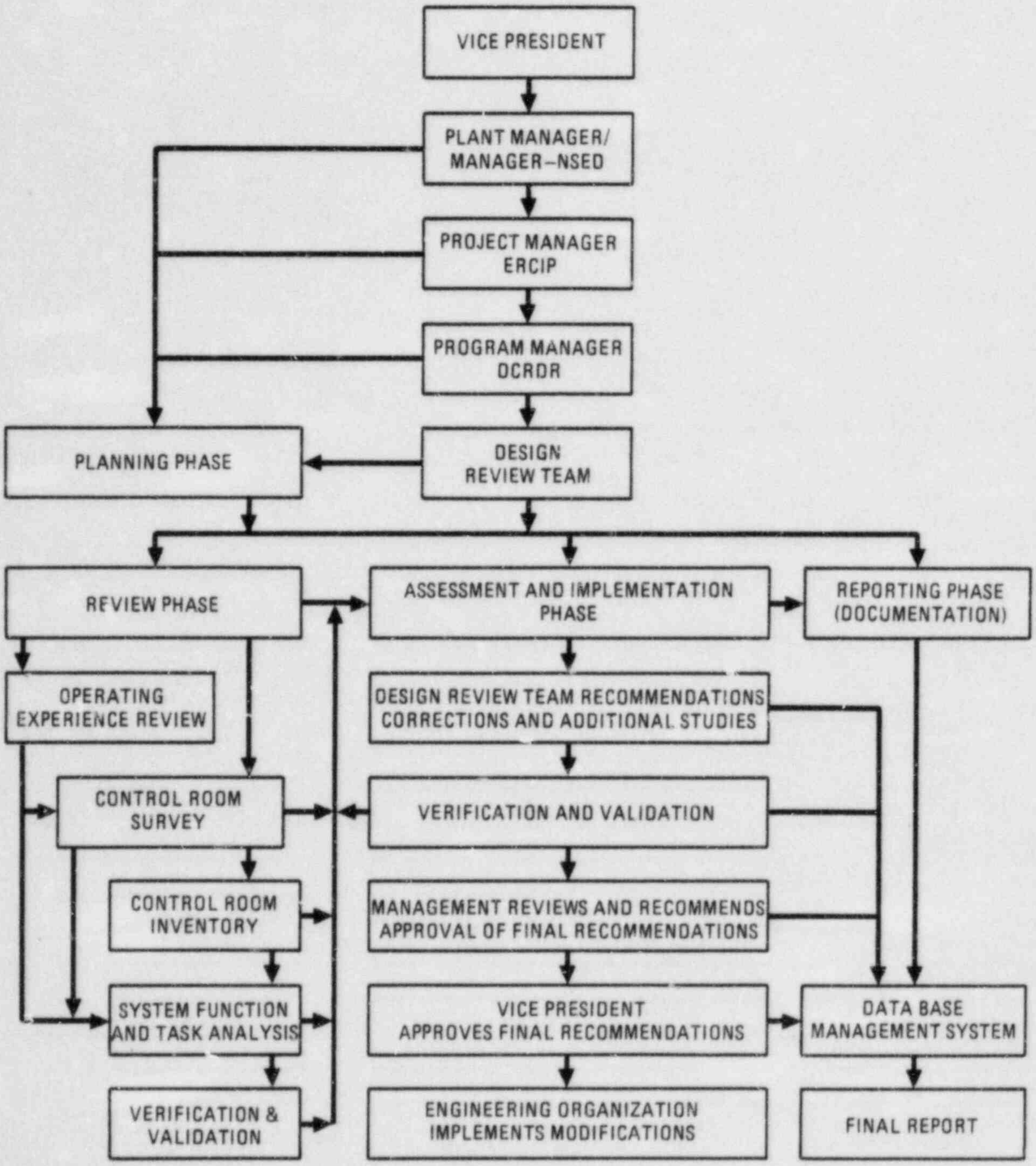
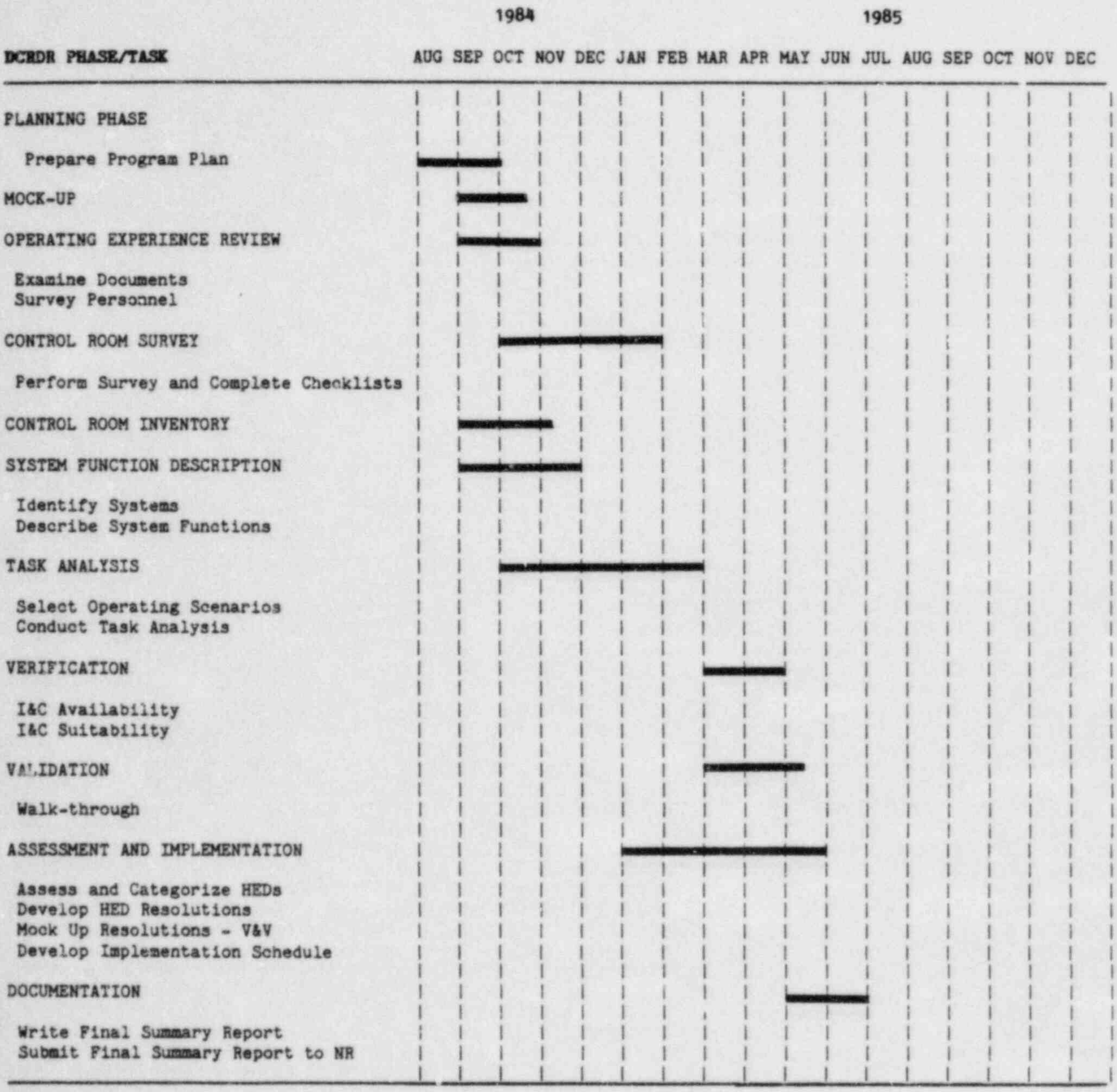


Figure 2-3. Formulation of the DCRDR Task Structure



Note: EOP V&V is integrated in the above schedule

Figure 2-4. Schedule of DCRDR Activities

3.0 DETAILED CONTROL ROOM DESIGN REVIEW METHODOLOGY

3.1 GENERAL

3.1.1 PROCEDURES

The tasks outlined for the DCRDR in Figure 2-3 will be conducted by members of the Design Review Team whose specialties fit the particular task. The appropriate Design Review Team members will be divided into Task Teams. Each Task Team will hold an initial meeting and prepare a detailed task procedure which will be reviewed by the Principal Investigator and approved by the Program Manager. Each procedure will include as applicable the following:

- o Purpose
- o Applicability
- o References
- o Responsibilities
- o Requirements for the task
- o Guidelines and checklists (if necessary)
- o Methodology for each task element
- o Organization for task execution
- o Flow diagram (if necessary)
- o Report outline (if report is required)
- o Effective date for using procedure

Appendix B is a typical procedure.

A project interface procedure will be prepared to define the duties and general methodology for the Task Team's activities. This will be done during the initial meeting of the Task Team.

This procedure will be approved by the DCRDR Program Manager and will be used and updated as required.

Note 1: The DCRDR Program Manager has the option for direct approval or for a consensus approval by the Design Review Team of all procedures.

Note 2: Procedures are living documents and can be modified, with approval, as the need and experience dictates.

A library of plant documents will be established for the Design Review Team. It will contain many of the human engineering documents referenced in NUREG-0700, EPRI documents and the following plant documents:

- o Licensee Event Reports
- o Final Safety Analysis Report
- o Systems Descriptions
- o Piping and Instrumentation Drawings
- o Control Room Floor Plan
- o Panel Layout Drawings
- o Panel Photographs
- o Lists of acronyms and abbreviations used in the control room
- o Descriptions of coding conventions used in the control room
- o Procedures (emergency,operating,etc.)
- o Operator training materials for EOPs
- o Control Room Preliminary Design Assessment Report
- o Generic Control Room Design Review Report
- o Guidelines for Procedure Development (per I.C.1 and NUREG-0799)
- o BWR Owners' Group Control Room Design Summary Report
- o SPDS Preimplementation Package, Functional Design Description and Requirements Document
- o Clinton Power Station Unit 1 Supplement 1 to NUREG-0737 Requirements for Emergency Response Capability - Emergency Response Capability Implementation Plan (ERCIP) (Submitted to the NRC)
- o Control Room Inventory
- o Instrument Lists
- o EOP - Procedures Generation Package (NRC submittal)
- o Draft Technical Specifications

3.1.2 Criteria

The Design Review Team will prepare a Criteria Report. This effort will stress the human factors considerations and requirements for the control room. This document will describe the function of the control room and plant systems. It will also include the control room conventions, human factors data such as labeling, lighting etc. and will define ongoing procedures to assure the continued application of human factors principles to future control room design changes, including verification and validation of changes.

Criteria will be developed considering:

- o Those human factors engineering practices that have general industry acceptance and have resulted in proven performance.

- o Pertinent NUREG documents, BWROG documents and Regulatory Guides.

- o Established criteria from general industry, EPRI, INPO, government sources, Illinois Power Company conventions, standards and practices.

3.1.3 Data Base Management System

Several major tasks in this DCRDR will involve the collection, filing, comparing and sorting of large amounts of related data. The most significant of these tasks are:

- o System Function and Task Analysis and EOP Validation and Verification
- o Control Room Inventory
- o Control Room Survey

A Data Base Management System (DBMS) will be used for this DCRDR. This system is available on a mini-computer. This system has large storage capacity for storing large numbers of multiple field records. It also has a capability for sorting up to 16 fields and for linking files (groups of records) through a common field in each file.

The following are descriptions of the intended implementation of this DBMS for the tasks listed above.

System Function and Task Analysis & EOP V&V

The tabulation of task data involves the filing and sorting of information about each step in the event sequence such as step sequence number, step description, equipment number, panel number, operator, etc. These data will be stored and sorted by different fields for use in the traffic flow analysis and the task sequence analysis. Also by using the file linking option of the DBMS, the task analysis file can be linked with the control room inventory file via the device field in both files. This provides an automated method for verifying the presence of the devices and characteristics of devices required to accomplish the operator action.

Control Room Inventory

The control room inventory requires the compilation of a complete list of the control room devices. This information will be recorded and sorted using the DBMS. Some of the detailed data required for each device are as follows:

- Device number
- Panel number
- Device location coordinates
- System
- Device type
- Switch positions
- Instrument range
- Instrument division
- Device label
- Device manufacturer

This information will be sorted by panel to provide a file of information for evaluating the inventory of equipment required for the events reviewed in the task analysis.

Control Room Survey

The control room survey requires reporting and sorting of human engineering observations. The DBMS not only provides the capability for filing and reporting this information but the "sort" option can provide quick reference to all the HEOs for a particular device or to all the HEOs for a particular panel or panel face.

3.2 OPERATING EXPERIENCE REVIEW

3.2.1 Purpose

The purpose of the Operating Experience Review (OER) is to provide early input regarding plant operating experience from the operations personnel most familiar with control rooms for use by the human factors and task analysis Design Review Team members. This will allow for special attention of known observations.

The OER will address three distinct elements, i.e. a review of:

- o Plant operating experience (experience of similar plants).
- o Operations personnel responses to a structured questionnaire.
- o Responses to data collected during interviews of operations personnel.

3.2.2 METHODOLOGY

This review will be performed by the Operating Experience Review Task Team identified in Table 2-1.

Review of Operating History Documents

A review of human errors made during plant operation will be performed. This review will include the Significant Operating Experience Reports (SOERs) and Licensee Event Reports (LERs) for BWRs (types 4,5 and 6) over the last three years. Individual reports will be reviewed to determine potential human factors involvement. Those items that are suspect will be reviewed further during the operations personnel interviews. If the interviews indicate human factors involvement, they will be given to the Control Room Survey Task Team or the System Function and Task Analysis Task Team for background information. The LERs/SOERs will be reviewed for human factors implications for the events involving:

1. A detection error due to high workload, high noise level, poor location of signal, confusion of alarms due to poor legibility or poor grouping of alarm in location.

2. A display identification error due to inadequate labeling, inadequate differentiation by shape, color, grouping or demarcation, poor display legibility, inadequate display scale, inappropriate scale units requiring mental conversion.

3. A decision error due to inadequate training, insufficient information available, poor integration of information or lack of decision aids or diagnostic procedures.

4. A procedure error due to inadequate training, procedures poorly written or organized or panel layout not corresponding to the operating sequence.

5. An execution error due to inadequate labeling; inadequate differentiation of controls caused by shape, color coding, grouping or demarcation, violation of movement sterotype, inadequate labeling of control position; inadequate device feedback, or insufficient training.

6. A communication error due to inconveniently located or insufficient communication equipment, poor signal-to-noise ratio of communication system or lack of standard lexicon or syntax for messages.

7. A side effect error due to devices poorly positioned in workspace or due to a crowded workspace.

Review of Questionnaire Responses

A questionnaire booklet will be prepared covering the following topics:

- o Workspace and Environment
- o Communications
- o Annunciator Warning Systems
- o Controls
- o Visual Displays
- o Labels and Location Aids
- o Process Computers
- o Panel Layout
- o Control-Display Integration
- o Procedures, Manning and Training
- o Control Room Equipment and Storage

The booklet will be processed through the Design Review Team and distributed to operations personnel trained or receiving training in the following disciplines:

- o Reactor Operators
- o Senior Reactor Operators
- o Unit Shift Supervisors
- o Shift Technical Advisors
- o Appropriate station management and training personnel

Questions will be posed such that the responses requiring an explanation will be indicative of an undesirable or problematical control room design aspect. For these responses, respondents will be asked to explain the specific problem or deficiency and, if applicable, to identify the panel, system, equipment, and/or component. See Appendix C for typical questions and format structure to be used.

The questionnaire booklets will be distributed to the majority of plant operations crews and other personnel with past nuclear plant operating experience.

The responses to the questionnaires will be analyzed by the Task Team with the following objectives:

1. Determine those problem areas that should be explored in more detail during the interviews.

2. Provide the Control Room Survey and System Function and Task Analysis Task Teams with reference material.

3. Provide reference material for Human Engineering Observations (HEOs) that will be prepared in the later task efforts.

4. Provide summary results for the OER report.

Review of Interview Responses

The human factors consultant (Torrey Pines Technology) will handle the operations personnel interviews exclusively. A majority of the Illinois Power Company operations personnel will be interviewed consistent with availability. Interviews will take place in the vicinity of the central control room or simulator equipment to facilitate visual explanations of problem areas, if any.

The interviews will be based on the results of the questionnaire responses and the following considerations:

1. Interviews will identify those aspects of the main control room equipment layout and general design which operations personnel consider as improvements in performing control room functions.

2. Questions will be focused on those details of the main control room environment which are projected to indicate notable success, failure and potential problem situations based on past experiences.

3. Respondents will be advised that the information obtained will not be used for performance evaluation purposes. (Project procedures will assure that comments by operations personnel will remain anonymous.)

4. Respondents will be encouraged to speak openly about problems from their past experience or perceived potential problems and suggested solutions.

5. Other questionnaires developed by industry and research groups in previous projects.

6. Interviews will be structured to allow for additions of material developed during the interview and verification of data.

The data evaluation will be done immediately following completion of the interview period to assure maximum benefit from the interview. The data evaluation results will be forwarded to the Program Manager for review. An additional review of areas of significant changes may be required.

Human Engineering Observations will not be prepared for the Operating Experience Review task unless an observation not covered by a criteria in Section 6 of NUREG-0700 is discovered. All problem areas or "Observations" will be noted as "Operating Experience Review Observations". These Observations will be tied into a NUREG-0700, Section 6 guideline and the validity of these Observations will be established during the Control Room Survey and/or System Function and Task Analysis.

3.3 CONTROL ROOM INVENTORY

3.3.1 Purpose

An inventory of controls, instrumentation, displays and other equipment on the control room man/machine interfaces will be conducted. This inventory will establish a reference data base for comparison with the requirements established by operator task analysis.

3.3.2 Methodology

The following will be done by the Control Room Inventory Task Team identified in Table 2-1 in performing the inventory:

- **Device Number**

  A device number will be used in the event the Instrument Number proves unsuitable for data base manipulation. This device number will be arbitrarily assigned to each instrument to facilitate accountability and quality in compiling the inventory. These same numbers will also be on labels affixed to the full-scale mock-up. These device numbers will be unique and as such will be used exclusively with the Control Room Survey and Systems Function and Task Analysis. The device number will be used to identify instruments not complying with NUREG-0700 Section 6 guidelines and will be listed in any HEOs generated. The System Function and Task Analysis task will also use these numbers to outline the operator steps.

- **Instrument Numbers***

  Instrument numbers will be used (or assigned to the items in the inventory) in order to identify the type of instrument in question.

(*) Generic term referring to all control panel devices

- **Service Description**

  Information will be included in order to either create a non-existent label or to render more definitive the information given in the label; P&IDs, the Instrument Index, FSAR, or GE documents will be consulted at various times for more definitive information.

- **System Number**

  System numbers will be assigned based on the Clinton Power Station System Index.

- **Manufacturer/Model**

  This data will be collected as available.

- **Range/Units**

  These values will be collected from the photomosaic and other plant documents and will be used during the verification and validation effort of the DCRDR program.

- **Minimum Scale Increment**

  These values will be collected from the photomosaic and other plant documents and will be used during the verification and validation effort of the DCRDR.

- **Panel Number**

  The numbers will be as established.

Data from the inventory will be added to the DBMS defined earlier.

An example of an inventory sheet is shown in Figure 3-1.

3.4 CONTROL ROOM SURVEY

3.4.1 Purpose

A survey of the full-scale mock-up and the Clinton Power Station control room will be performed to evaluate compliance with the control room criteria document. The use of a realistic mock-up will permit completion of the bulk of the checklist items developed without interfering with control room construction. Those items that cannot be evaluated on the mock-up, such as control room workspace, communication devices, illumination, use of protective clothing and other environmental considerations, will be completed using the main control room in actual service conditions. The control room noise survey will be conducted while the plant is in power operation.

The objectives of the Control Room Survey will be to:

- o Identify characteristics of the control room instrumentation and physical arrangements that may impact operator performance.
- o Determine whether the control room provides the system status information, control capabilities, feedback, and analytical aids necessary for effective plant operation.
- o Provide recommendations for correcting problems based on good human factors principles.

3.4.2 Methodology

The Control Room Survey will be conducted using nine checklists to be developed from the Criteria Report (essentially to Section 6, NUREG-0700). It will be performed by the Control Room Survey Task Team identified in Table 2-1. The checklists to be developed will cover:

- 6.1 Control Room Workspace
- 6.2 Communications
- 6.3 Annunciator Warning Systems
- 6.4 Controls
- 6.5 Visual Displays
- 6.6 Labels and Location Aids
- 6.7 Process Computers
- 6.8 Panel Layouts
- 6.9 Control-Display Integration

and will use the same number and title contained in NUREG-0700, Section 6.

Each checklist will contain a title page, detailed description of the criteria and a reference/comment form to allow the observer to expand on any potential deficiencies discovered in the survey (See Figures 3-2 and 3-3). The basis for each criteria judgement will be established in the Criteria Report. The Criteria Report will identify NUREG-0700, and other criteria as appropriate for this survey. By performing the Control Room Survey in this fashion, every item addressed in Section 6 of NUREG-0700 will be addressed.

Any items identified as not meeting the guideline criteria will be documented as Human Engineering Observations (HEOs). Each HEO will contain a brief description of the observation, the potential operator error and a recommended good human factors resolution.

The procedure for evaluating the HEOs generated by the Control Room Survey is discussed in Section 4.0.

3.5 EOP AND DCRDR INTEGRATED SYSTEM FUNCTION AND TASK ANALYSIS

3.5.1 Purpose

The purpose of the System Function and Task Analysis (SFTA) is to analyze the ability of the plant operating crew to use the control room man/machine interfaces, Emergency Operating Procedures, communications and other control room facilities to operate the plant safely under emergency conditions. This task employs the techniques of reviewing the entry and exit conditions for the emergency operations.

3.5.2 Methodology

The SFTA methodology will constitute a structured review and analysis conducted:

- o According to the guidelines presented in NUREG-0700 for the DCRDR.
- o To meet the requirements of the EOP Verification and Validation (EOP V&V) program.

It will be performed by the SFTA Task Team members identified in Table 2-1. The results of the review and analysis will be assembled into data sheets and diagrams showing operator tasks, actions and movements required for use in the Verification and Validation phases of the DCRDR and EOP V&V (Sections 3.6 and 3.7).

The Illinois Power Company has already performed a review of the generic BWR Emergency Procedure Guidelines (EPGs) as well as the plant-specific EPGs to determine Clinton Power Station information and control needs. As part of the SFTA task, this review methodology will be documented and a detailed verification will be performed to ensure the adequacy of this review. This verification will provide consistency with the remainder of the DCRDR and the EOP V&V.

The integration of these activities is shown in Figure 3-4 and as indicated therein, parts of the EOP V&V will be completed in support of the SFTA.

This work will include the following:

1. Document Review

   The initial activity in the SFTA will be to review the following documents related to plant design and operation as they pertain to the DCRDR and EOP V&V:

   - o FSAR
   - o System Descriptions
   - o Emergency Procedure Guidelines
   - o Emergency Operating Procedures
   - o Plant Operating Procedures
   - o Draft Technical Specifications
   - o P&IDs
   - o EOP Verification and Validation Program

2. System and EOP Data Collection

   This activity will document the system and EOP information as a worksheet for use in the event selection process as well as for general use in the DCRDR and EOP V&V. The format shown in Figure 3-5 will be used which contains the following characteristics:

   - o System - Identifies major systems presented in the FSAR.
   - o Basic Plant Safety Function - Identifies systems by basic safety function performed.

- o EOP - Identifies systems addressed in the EOPs that require some form of operator attention related to its basic plant safety function.
- o SOE - Identifies systems ultimately addressed in the Selected Operating Event (SOE).

3. Selection of Events for Analysis

The following criteria will be used in the selection of events:

- o Utilize a broad range of control room functions.
- o Require time-dependent action by the operator.
- o Require multisystem operation and interaction by the operator.
- o Represent potentially high-stress situations for the operator.
- o Addresses all non-identical EOP operator tasks.
- o Addresses all identical EOP operator tasks at least once.

However, to prevent the transmitting of EOP errors into the subsequent DCRDR and EOP V&V phases, Parts IV.A, IV.C.1 and IV.C.3 of the EOP V&V (see Figure 3-4) will be completed prior to selecting the events. This activity will be conducted as described in the EOP V&V program.

The SFTA Task Team will use an interactive process involving Figure 3-5, the EOPs and the above selection criteria as follows:

- o Select an initial set of Initiating Events using Figure 3-5 and selection criteria.

- o Determine the EOP flow-paths for each Initiating Event.

- o Evaluate systems addressed on each EOP flow-path against selection criteria and revise the initiating event and/or the selected EOP flow path accordingly.

- o Evaluate operator decision-points on each EOP flow-path against the selection criteria and add to each Initiating Event the assumption of concurrent or subsequent system failures as necessary.

4. EOP and SOE Data Collection

   In this activity, the EOP-specific and SOE-specific data will be collected which will consist of the following major activities for each EOP:

   - o Operator Task Data - formulation of task description and requirements for primary and alternate tasks from the EOP flow-paths including an estimate of related system status based on an estimate of elapsed-time, principally from the FSAR (see Figure 3-6). This activity will be independent of the control room panels.

   - o Operator Step Data - formulation of step description per task and identification of control room devices that the operator could use for each step on the EOP flow-path using principally the photomosaic mock-up of the control room (see Figure 3.-7).

     The EOP task and step data applicable to each SOE will be identified per SOE in a similar manner.

5. SFTA Data Base

The SFTA data base will be one of three in the Data Base Management System defined for the DCRDR of the Clinton Power Station. The data base will be a collection of data records as shown in Figure 3-8. Various collections of these data records will comprise the data sheets which in turn form the basis for the link diagrams.

6. EOP and SOE Data Sheets

The EOP and SOE data will be entered into the SFTA data base and the necessary manipulations between data bases will be made. However, to prevent the transmitting of EOP errors into the subsequent DCRDR and EOP V&V phases, Part IV.C.2.b of the EOP V&V (see Figure 3-4) will be completed at this point in the SFTA. The necessary data sheets (see Figure 3-11) will be generated from the SFTA data base and the evaluation performed according to the EOP V&V program. Any revisions to the data base resulting therefrom will be made and the data sheets and diagrams for the Verification and Validation phases will be produced (see Figures 3-9, 3-10, 3-11, 3-12 and 3-13).

3.6 EOP AND DCRDR INTEGRATED VERIFICATION

3.6.1 Purpose

The purpose of the verification of task performance and capabilities is to determine that instrumentation and controls with the characteristics identified in the task analysis (Section 3.5) are available and suitable for the operating crew to perform the approved emergency operations.

3.6.2 Methodology

The Verification Phase will be conducted:

- o In a manner consistent with the objectives of NUREG-0700 for the DCRDR.
- o To meet the requirements of the EOP V&V program.

It will be performed by the Verification Task Team members identified in Table 2-1.

The results of the verification will be:

- o Specific Human Engineering Observations (HEOs) submitted for assessment or potential HEOs forwarded to the Validation Phase for further evaluation.
- o Discrepancies in the EOPs documented and resolved per the EOP V&V program.

The integration of these activities is shown in Figures 3-4 and 3-14. As indicated therein, parts of the EOP verification will have been completed in support of the SFTA (Section 3.5) and part of the EOP validation will be completed in support of the remaining verification activities.

The checklists and/or guides that will be used for the remaining parts of the EOP verification are documented in the EOP V&V program.

The checklists that will be used for DCRDR verification will be the same as those used in the Control Room Survey. They will be distinguished from the CRS checklists through the use of a separate form (see Figure 3-15). The criteria matrix will indicate those guidelines requiring SFTA data and will be the focus of the DCRDR verification. This will have the added benefit of inherently including the results of the CRS and OER in the verification (and validation) process.

Execution of the EOP and DCRDR checklists and/or guides will consist primarily of evaluating the data sheets and diagrams produced by the SFTA for guideline compliance. This will be analogous to the evaluation of the control panels in the Control Room Survey of the DCRDR.

In addition to the above data sheets and diagrams, guideline-specific or task-specific data groupings will be obtained from the SFTA or Control Room Inventory data bases as necessary to facilitate evaluation.

In evaluating the data sheets and diagrams, the following additional guidelines will be used.

- o Steps which occur near the boundary line between the two panels may be within the same workspace (devices may be on separate panels but still grouped together).

- o For overall system monitoring tasks, it is considered acceptable for the steps to occur on more than one panel.

- o Non-emergency SOEs (plant startup), if any, are not constrained by time or stress as is the case for emergency events thus grouping of tasks on two adjacent panels may be considered acceptable.

- o Tasks or functions occurring on more than one panel may be acceptable if more than one operator is involved.

- o Tasks or functions occurring on two or more adjacent panels may be acceptable if one or more of the panels is a very small or short panel.

- o Tasks which have steps that occur on both a console and the corresponding, but separate, vertical panel are acceptable if the vertical panel step is an observation of an instrument or status light that can easily be seen from the console position.

For the documentation and resolution of EOP discrepancies, the provisions of the EOP V&V program will be used.

For documentation of non-compliance with a DCRDR guideline, existing HEOs for the guideline will be reviewed for revision possibilities. Lacking same, a new HEO will be prepared.

Potential non-compliance with a DCRDR guideline will be identified on a task basis for further evaluation in the Validation Phase.

3.7 EOP AND DCRDR INTEGRATED VALIDATION

3.7.1 Purpose

The purpose of the validation of function execution is to determine that all the needs of the operating crew are available and suitable to perform the approved emergency operaticns.

3.7.2 Methodology

The Validation Phase will be conducted:

- o In a manner consistent with the objectives of NUREG-0700 for the DCRDR.
- o To meet the requirements of the EOP V&V program.

It will be performed by the Validation Task Team members identified in Table 2-1. The results of the validation will be:

- o Discrepancies in the EOPs documented and resolved per EOP V&V program.
- o Resolved potential HEOs from the Verification Phase and additional HEOs for submittal for assessment.

The integration of these activities is shown in Figures 3-14 and 3-16 and as indicated therein, part of the EOP validation will have been completed in support of verification.

The checklists and/or guides that will be used in the remaining parts of the EOP validation are documented in the EOP V&V program.

As in the DCRDR Verification Phase (Section 3.6), the Control Room Survey Checklists will be used along with the same reference/comment form (Figure 3-15).

The selection of operator tasks and SOEs for validation will be made from a comprehensive evaluation of all tasks of all SOEs using the following criteria:

- o Maximizes operator workstation utilization, potential stress, interaction and workload.
- o Addresses all significant operator tasks.
- o Addresses all potential HEOs identified in the Verification Phase.
- o Addresses all unresolved EOP discrepancies.

The validation will use both walk/talk-through and simulator methods.

3.7.2.1 Walk/Talk-Through Method

A procedure will be developed based on the photo-mosaic mockup of the control room.

The procedure will consist of the following principal elements:

- o Use of three observers with the lead observer directing all activity using the appropriate SFTA data sheets and diagrams from the Verification Phase.
- o Two operators will execute tasks as directed by the lead observer.

- o Execution of the checklists and guides for guideline compliance.
- o Video/audio recording of all activity.

The execution of the walk/talk-through procedure will inherently include the execution of the checklists and guides. Operator activity will be initiated by the lead observer giving plant symptoms or task descriptions from the SFTA data sheets. The operator response will be the execution of a task sequence and/or steps to accomplish the task(s) which will be evaluated by the observers for DCRDR and EOP guideline compliance. The evaluation process will include frequent discussions with the operators and references to the Control Room Inventory data base or EOPs as necessary.

For the documentation and resolution of EOP discrepancies, the provisions in the EOP V&V program will be used.

The potential HEOs from the DCRDR Verification Phase will be resolved and any additional non-compliance with a guideline will be documented in the same manner as the Verification Phase (Section 3.6).

All tasks, potential HEOs and EOP discrepancies of a time-dependent nature will be noted for evaluation on the simulator.

3.7.2.2 Simulator Method

A procedure for validation on the control room simulator will be developed and will consist of essentially the same elements as the walk/talk-through procedure.

Operator activity will be initiated with the simulator at plant conditions closest to the plant symptoms or task specified by the lead observer. Operator response(s) to the simulator will be evaluated by the observers for DCRDR and EOP guideline compliance and will include frequent discussions with the operators and references to the Control Room Inventory and EOPs as necessary.

All outstanding potential HEOs will be resolved and EOP discrepancies will be documented and resolved per the EOP V&V program.

Figure 3-1.

(Typical)
DCRDR CONTROL ROOM INVENTORY

DEVICE NO	INSTRUMENT NUMBER	SERVICE DESCRIPTION	SYSTEM NUMBER	MANUFACTURER MODEL	RANGE UNITS	MIN SCALE INCR	BOARD NUMBER	PANEL ID
128.	XAN-3	(TURBINE BENCH BOARD C2 ANNUNCIATORS)	42	PANALARM	-	-	C2	1A/1B
129.	ZI-3022	BYPASS VLVS OPENING JACK POS	51	FOXBORO	0-100 PERCENT	2	C2	1A
130.	ZI-3021	MECH PRESS REG HND WHEEL POS	51		150-1050	50	C2	1A
131.	ZI-3020	MECH PRESS REG RELAY PISTON POS	51	FOXBORO	0-100 PERCENT	2	C2	1A
132.	ZI-3014	ELECT PRESS REG SERVO MTR POS	51	FOXBORO	0-100 PERCENT	2	C2	1A
133.	ZI-3013	PRESS CONTROL POS	51		910-1010 PSI	2	C2	1A
134.	ZI-3023	LOAD LIMIT PISTON POS	51	FOXBORO	0-100 PERCENT	2	C2	1A
135.	ZI-3024	SPEED & LOAD CHANGER POS	51	FOXBORO	0-100 PERCENT	2	C2	1B
136.	PI-3049	STEAM CHEST PRESS	1	FOXBORO	0-2 PSIG X 1000	0.05	C2	1B
137.	PI-3052	TURB 1ST STAGE PRESS	1		0-900 PSIG	25	C2	1B
138.	XZI-8	NO. 1 CNTR VLV ABOVE SEAT DRAIN	1		G-R LITES	-	C2	1B
139.	XZI-9	NO. 2 CNTR VLV ABOVE SEAT DRAIN	1		G-R LITES	-	C2	1B
140.	XZI-10	NO. 3 CNTR VLV ABOVE SEAT DRAIN	1		G-R LITES	-	C2	1B

GUIDELINE

6.2.1.1 GENERAL REQUIREMENTS FOR VOICE COMMUNICATION SYSTEMS

Generally there are six varieties of voice communication systems found in control rooms: Conventional-powered telephones, sound-powered telephones, walkie-talkie radio transceivers, fixed-band UHF transceivers, announcing systems, and point-to-point intercom systems. Human factors requirements specific to each type of voice communication system will be considered individually in Guidelines 6.2.1.2 through 6.2.1.7 while 6.2.1.8 will address voice communication by the operator wearing an emergency mask. The following requirements are relevant to communication systems in general.

a. INSTRUCTIONS—Instructions should be provided for use of each communication system, including suggested alternatives if a system becomes inoperable.

b. PERIODIC MAINTENANCE TESTS—These should be performed on all communication systems to ensure that the system is normally operative and effective under changes in ambient noise levels that may have occurred since the last check.

c. EMERGENCY MESSAGES

(1) OUTGOING—Priority procedures should be established for the transmission of emergency messages from the control room by any of the communication systems.

(2) INCOMING—Procedures should be established for handling communications during an emergency and these procedures must be known by all operators.

COMPLIANCE CHECKLIST

N/A	Yes	No	Reference/Comment

Figure 3-2. Sample Compliance Checklist

DETAILED CONTROL ROOM DESIGN REVIEW
CONTROL ROOM SURVEY
REFERENCE/COMMENT FORM

OBSERVER: ______________________ DATE: __________ PAGE ___ OF ___

LOCATION: ______________________

GUIDELINE CRITERIA ITEM NO.: ______________ HED REFERENCE NO.: __________

CRITERIA ELEMENT NO.	PANEL/ CONSOLE NO.	SUBPANEL	REFERENCE/COMMENT
DIAGRAM/PHOTO NO.:			

rm

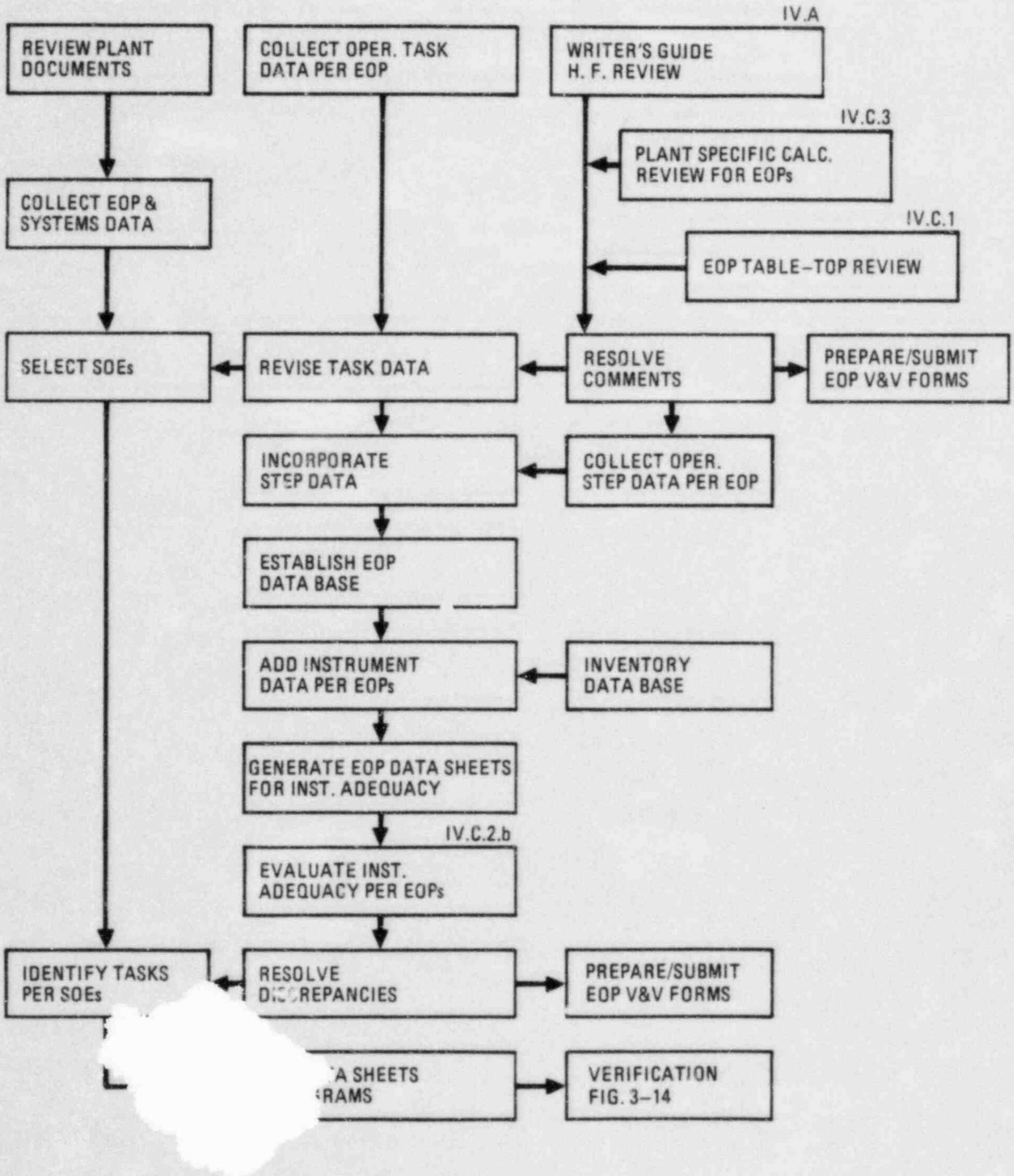


Figure 3-4. EOP and DCRDR Integrated System Function and Task Analysis

System No.	Basic Plant Safety Function(1)				EOP				SOE				
	A	B	C	D	01	02	03	04	1	2	3	4	5
1	X				X	X			X		X	X	
2	X						X			X			X
3		X											
4		X				X		X		X			
5			X										
6				X					X				
etc.													

(1) A = Core Cooling; B = Primary Containment Integrity;
C = Reactivity Control; D = Fission Product Control

Figure 3-5 Major Plant Systems Addressed and Utilized

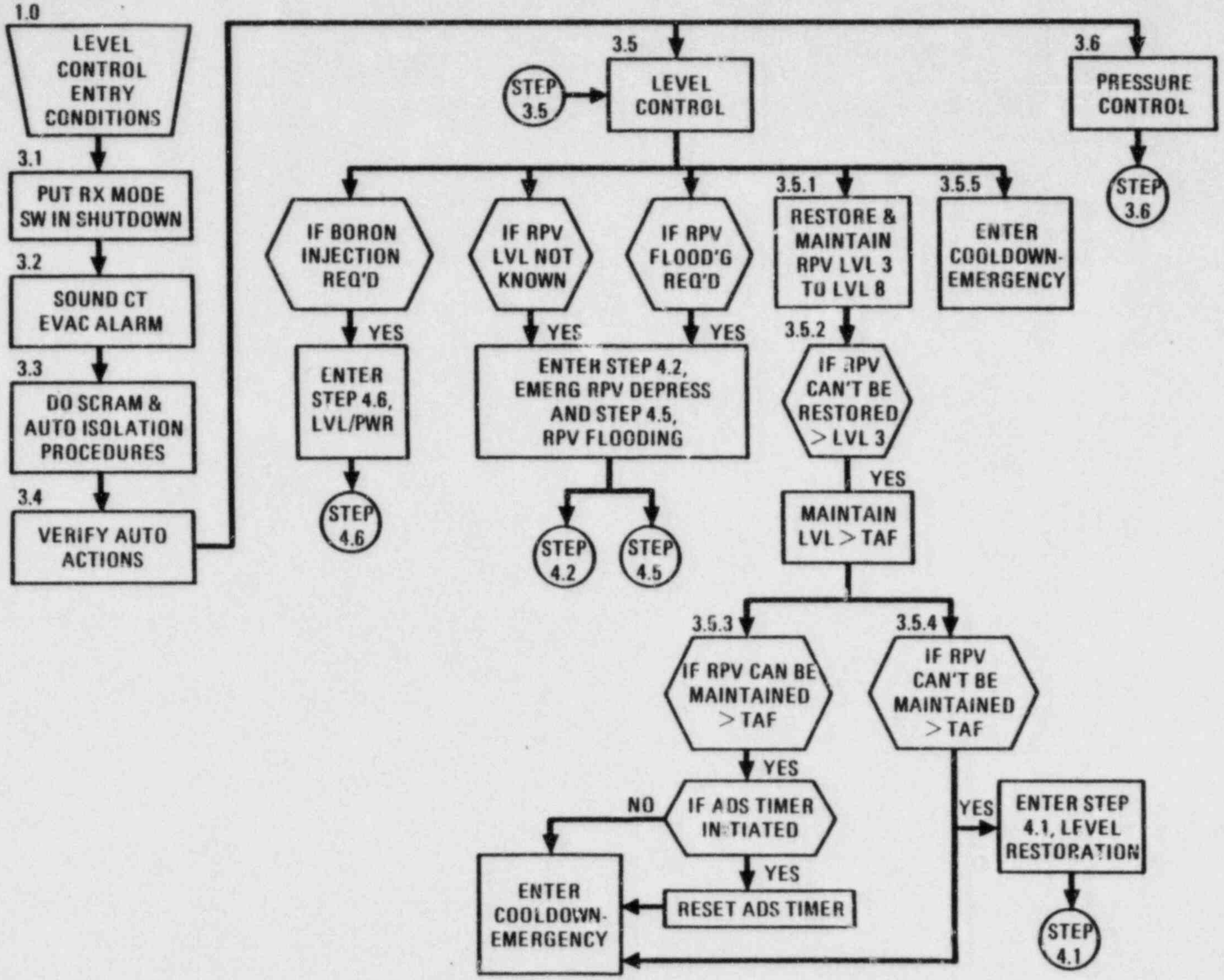


Figure 3-6. Sample EOP Flow Chart

Figure 3-7. Typical Photomosaic Mock-up

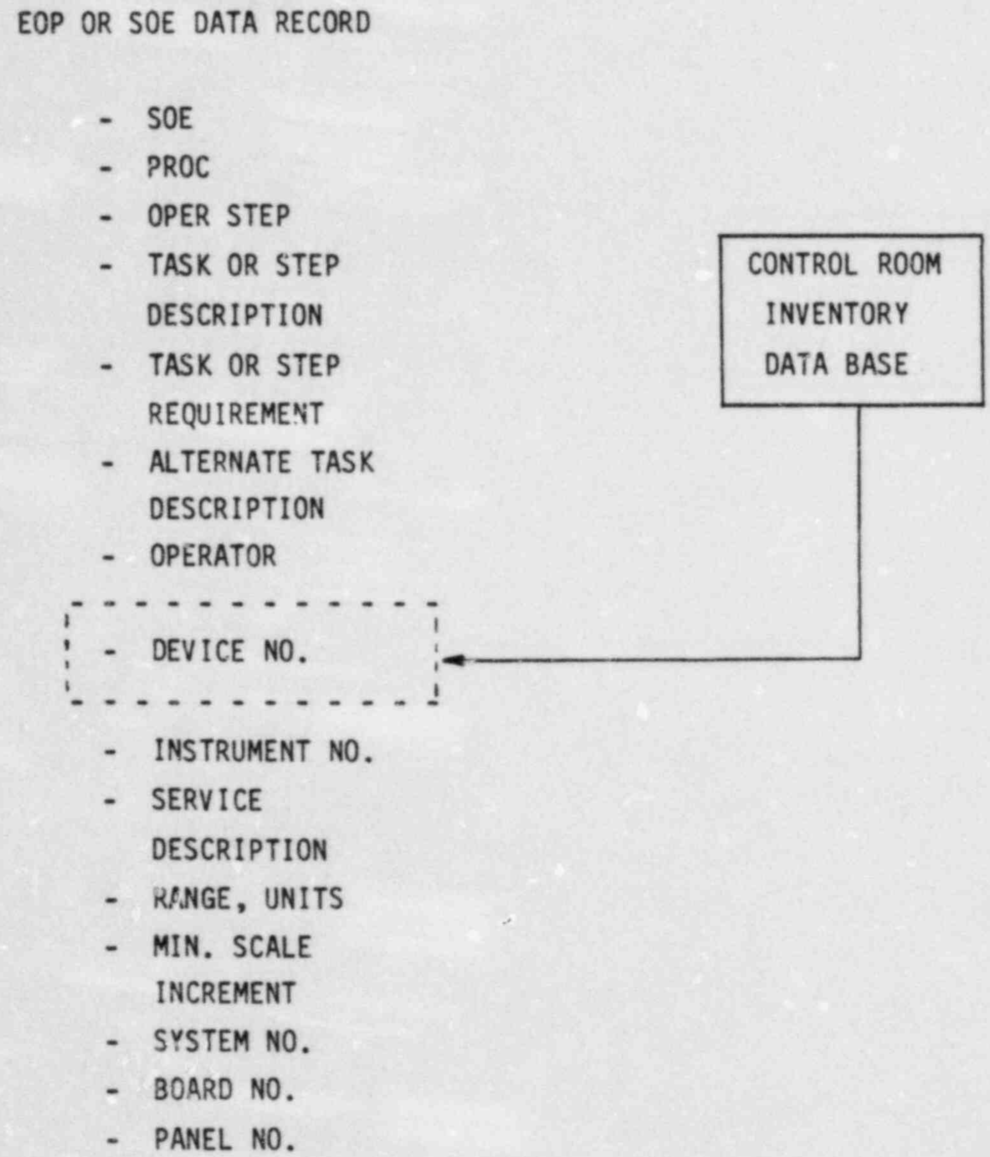


Figure 3-8. SFTA Data Base Record Definition

1.5/091984
VAXC/85

Figure 3-9.
(TYPICAL)
EOP & DCRDR INTEGRATED SFTA

EOP or SOE: --

DATA SHEET #1: OPERATOR PRIMARY & ALTERNATE TASKS

TASK DESCRIPTION	TASK REQUIREMENT	ALTERNATE TASK DESCRIPTION	REF
T: Monitor/adjust plantparameters during normal plant operation @ 100% power	Controls & indicators	N/A	___
T: Respond to numerous alarms and systems autoactions for EOP entry conditions	See subtasks	See subtasks	___
ST: Determine RPV water level	RPV water level < ___ inches above TAF	Initiate RPV flooding	___
ST: Determine DW pressure and temperature	DW pressure & temperature > ___ psig > ___ Deg-F	Assume DW press & temp entry conditions exist	___
ST: Determine SP level	SP level >+___ or <+___ inches	Assume SP level entry conditions exist	___
T: Verify Reactor scram	See subtasks	See subtasks	___
ST: Verify control rods inserting	Control Rod position Decreasing	Initiate reactor power control thru RPV water level & Boron injection	___
ST: Verify reactor power decreasing	Reactor power status Rapid decrease from 100%	Initiate reactor power control thru RPV water level & boron injection	___

Figure 3-10.

(TYPICAL)

EOP & DCRDR INTEGRATED SFTA

EOP or SOE: --

DATA SHEET #2: OPERATOR STEPS IN TASK SEQUENCE

SOE	REF	OPER STEP	TASK or STEP DESCRIPTION	TASK REQUIREMENT	DEVICE USED	ALTERNATE TASK DESCRIPTION	LOCATION SYSTEM NO	LOCATION BOARD NO	LOCATION PANEL NO	OPER
4	___	.10	T: Monitor/adjust plant parameters during normal plant operation @ 100% power	Controls & indicators		N/A				
4	___	1.00	T: Respond to numerous alarms and systems auto actions for EOP entry conditions	See subtasks		See subtasks				
4	___	1.05	ST: Determine RPV water level	RPV water level		Initiate RPV flooding				
4	___	1.07	Observe RPV water level	< ___ Inches above TAF	____________		___	___	___	___
4	___	1.09	Observe RPV water level	< ___ inches above TAF	____________		___	___	___	___
4	___	1.11	Observe RPV water level	< ___ inches above TAF	____________		___	___	___	___
4	___	1.13	Observe RPV water level	< ___ inches above TAF	____________		___	___	___	___
4	___	1.20	ST: Determine DW pressure and temperature	DW pressure & temperature		Assume DW press & temp entry conditions exist				

Figure 3-11.

(TYPICAL)
EOP & DCRDR INTEGRATED SFTA

EOP or SOE: --

DATA SHEET #3: INFORMATION & CONTROL CAPABILITY, REQUIRED vs AVAILABLE

SOE	REF	OPER STEP	TASK or STEP DESCRIPTION	TASK REQUIREMENT	DEVICE USED	SERVICE DESCRIPTION, RANGE, UNITS	MIN SCALE INCR	SYSTEM NO	LOCATION BOARD NO	LOCATION PANEL NO	OPER
4	____	.10	T: Monitor/adjust plant parameters during normal plant operation @ 100% power	Controls & indicators							
4	____	1.00	T: Respond to numerous alarms and systems auto actions for EOP entry conditions	See subtasks							
4	____	1.05	ST: Determine RPV water level	RPV water level							
4	____	1.07	Observe RPV water level	< ___ inches above TAF	____	(Service Description) ____________ (Range, Units) ____________	___.	___	___	___	___
4	____	1.09	Observe RPV water level	< ___ inches above TAF	____	(Service Description) ____________ (Range, Units) ____________	___	___	___	___	___
4	____	1.11	Observe RPV water level	< ___ inches above TAF	____	(Service Description) ____________ (Range, Units) ____________	___	___	___	___	___
4	____	1.13	Observe RPV water level	< ___ inches above TAF	____	(Service Description) ____________ (Range, Units) ____________	___	___	___	___	___
4	____	1.20	ST: Determine DW pressure and temperature	DW pressure & temperature							

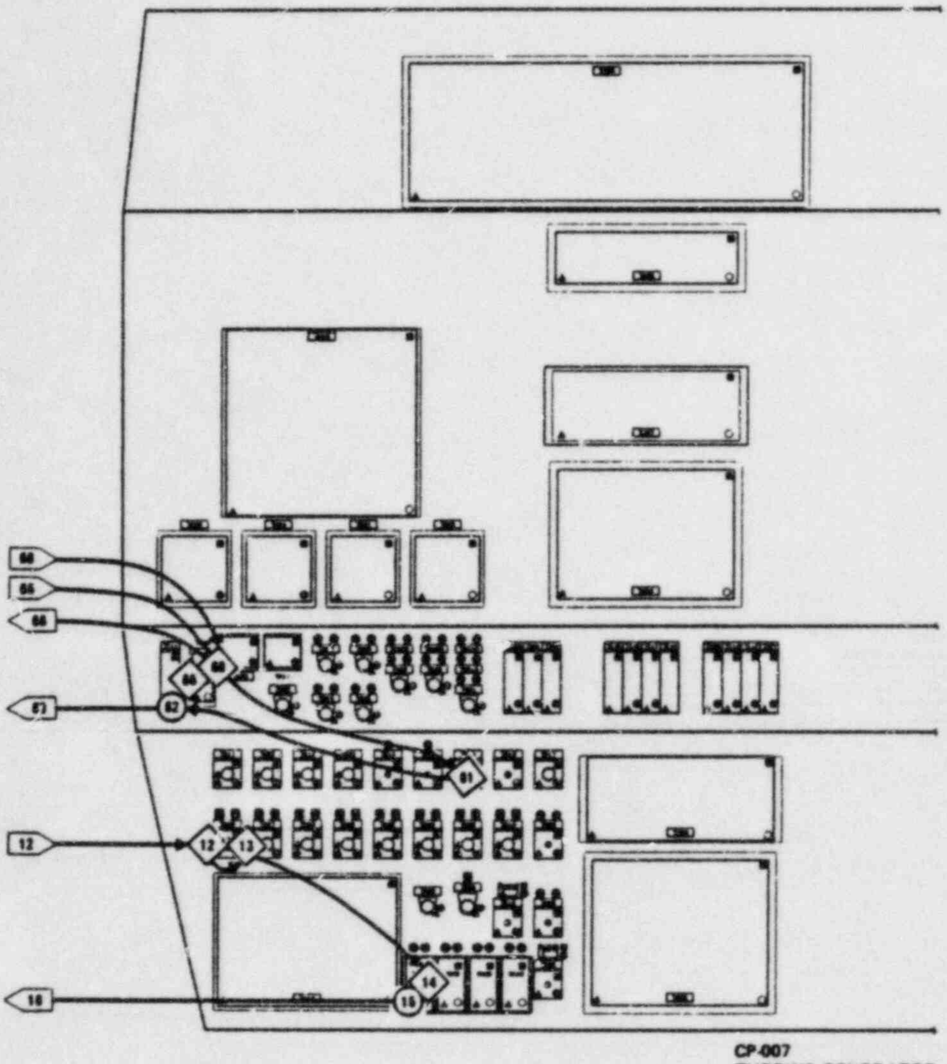


Figure 3-12. Sample Operational Sequence Diagram

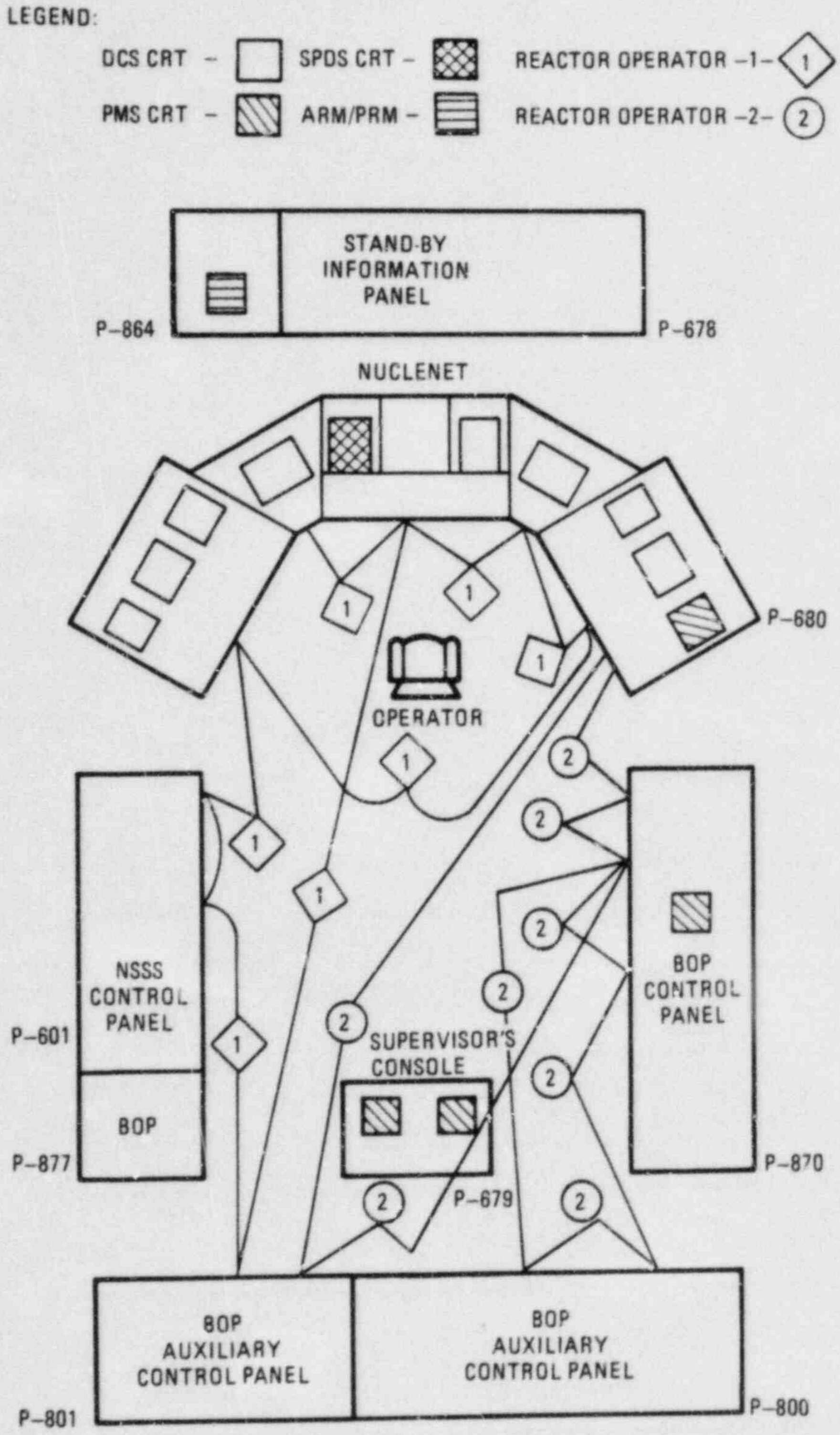


Figure 3-13. Typical Link Diagram

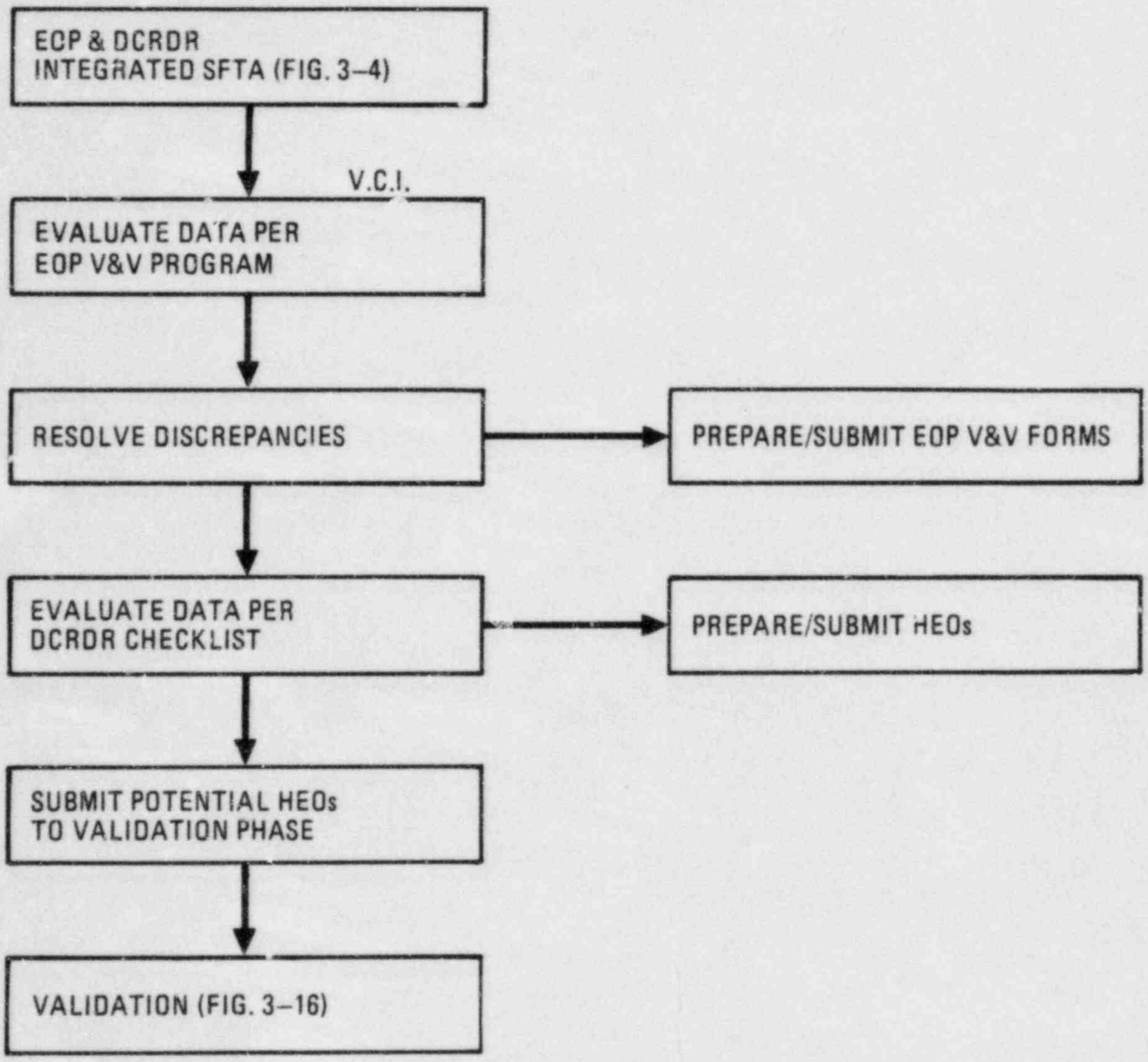


Figure 3-14. EOP & DCRDR Integrated Verification.

DETAILED CONTROL ROOM DESIGN REVIEW
VERIFICATION/ VALIDATION
REFERENCE/COMMENT FORM

OBSERVER: ______________________________ **DATE:** __________ **PAGE** ___ **OF** ___

LOCATION: ______________________________

GUIDELINE CRITERIA ITEM NO.: ______________ **HEO REFERENCE NO.:** __________

CRITERIA ELEMENT NO.	DATA SOURCE	PANEL/ CONSOLE NO	REFERENCE/COMMENT
DIAGRAM/PHOTO NO.:			

Figure 3-15. Sample Verification/Validation Reference/Comment Form

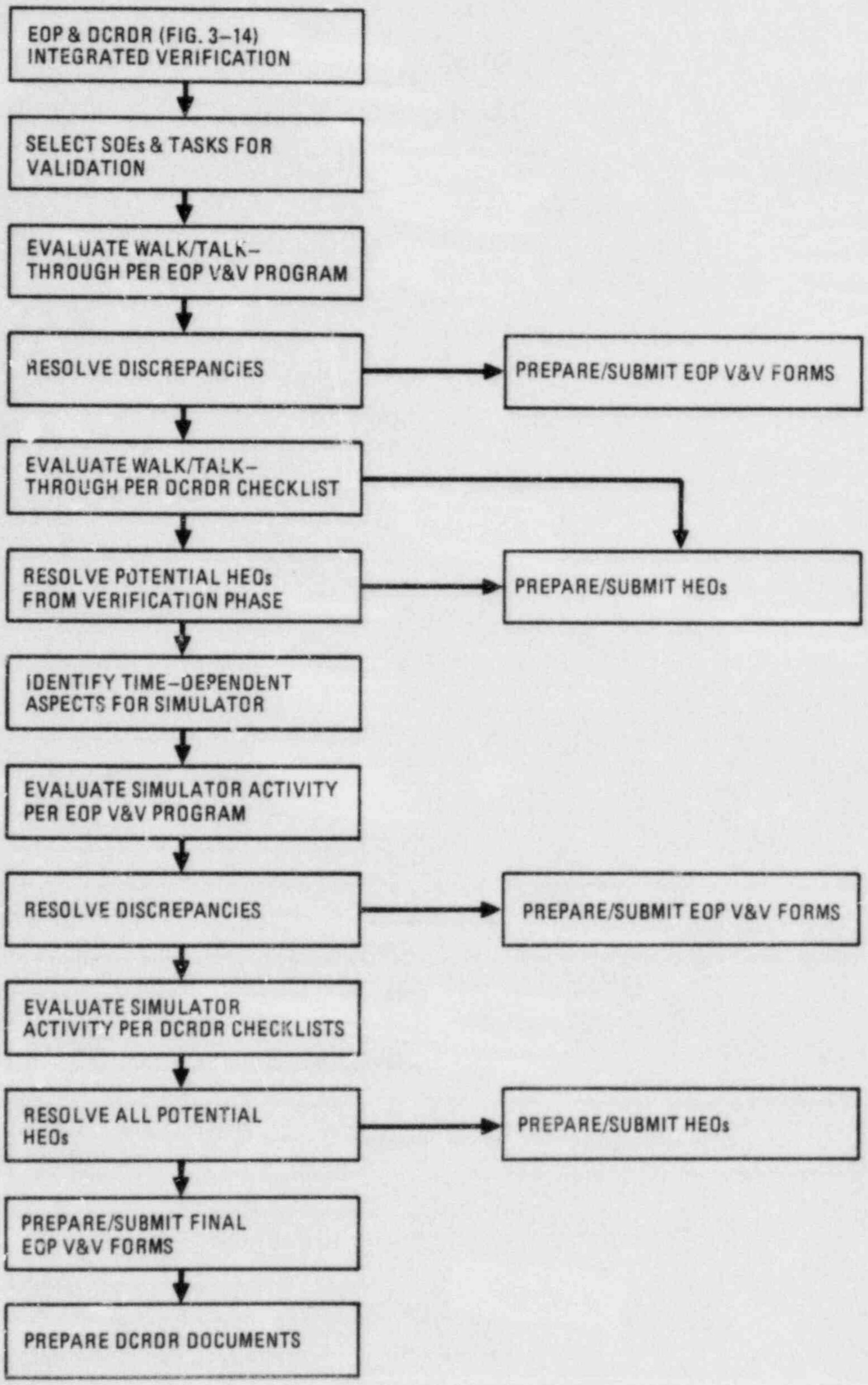


Figure 3-16. EOP and DCRDR Integrated Validation

4.0 DCRDR ASSESSMENT AND IMPLEMENTATION

The assessment for the dispositioning of all HEOs identified in the DCRDR will be conducted in a manner consistent with the objectives of NUREG-0700 and NUREG-0801 and will be performed by the Assessment and Implementation Team (AIT) identified in Table 2-1. The results of the assessment will be Human Engineering Discrepancies (HEDs, significant HEOs) with correction methods selected, and non-HEDs for which corrective actions will be optional.

The AIT will be assisted in this task by the assessment data base, one of three in the Data Base Management System defined for the DCRDR of the Clinton Power Station. The data base will be a collection of data records as defined in Section 3.1.3. Each record will be uniquely defined by the HEO number throughout the assessment. See Figure 4-1 for a sample printout of the HEO form.

The AIT will develop background information for this task from a review of the pertinent NRC documentation, NUREG-0737 Supplement 1, NUREG-0700 and NUREG-0801, this program plan, all summary reports issued by the Design Review Team and all the HEOs submitted to the AIT for review. Other references such as EPRI NP-2411, Human Engineering Guide for Enhancing Nuclear Control Rooms will be reviewed. In addition, the following information is required during the assessment meetings:

- Technical Specification Safety Limits
- Operating Limits
- Limiting Conditions for Operations
- LERs

4.1 OBJECTIVE

The objective of the Assessment and Implementation Task will be to evaluate the HEOs resulting from the program, assign categories, recommend appropriate corrective actions, schedules and methods for verifying and validating corrective actions and document the process.

4.2 METHODOLOGY

The assessment methodology developed for the Clinton Power Station is presented in Figure 4-2 which summarizes review team definition, team scope of responsibilities and HEO routing. The assessment process is defined in terms of HEO categorization (Figure 4-3) and analysis for corrections (Figure 4-4). A written procedure for HEO assessment will be developed by the AIT prior to the start of this process.

4.2.1 HEO/HED Categorization

Figures 4-2 through 4-6 show the categorization process. The following describes this process:

1. The AIT will review the entire HEO (Figure 4-1) as presented followed by an open discussion to assure complete understanding of the observation. The human factors specialist will be available to answer questions during this phase of the assessment. In this process, the AIT may request clarification of the wording of the HEO description. This will be covered in the comment section with reference to an attached rewording.

2. The AIT will then determine which category to assign the HEO under review. The process to be used is shown typically in Figure 4-3. The DCRDR process encourages the reporting of all observations, recognizing that the AIT is staffed with personnel qualified to assess the significance of each observation. Assessment will be based on an analysis of the impact of each observation on operating crew performance (workload) and overall plant safety and reliability. Those observations that are judged to have a high potential impact on plant safety and reliability will be categorized as HEDs per the classification rated below and the non-significant observations will be classified as HEOs. Tables 4-1 and 4-2 are modifications of NUREG-0801 criteria to be used to assess the significance of HEOs. The four categories to be used in the categorization process are defined below:

   1. Category A - HEOs Associated with Documented or Potential Errors.

      Category A includes HEOs which are known to have previously caused or contributed to an operating error as documented in a Licensee Event Report (LER) or other historical record, or as established by the interview (or questionnaire) responses of operations personnel, or which have the potential to cause an error of high safety consequence.

   2. Category B - HEOs Associated with Safety Considerations.

      Category B includes those HEOs that have a low potential to cause an unsafe condition.

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3. Category C - HEOs Associated with Availability or Reliability Considerations.

   Category C includes HEOs which have been assessed and determined to have minimal potential for causing or contributing to unsafe conditions but impact electrical generating capabilities.

4. Category D - HEOs that are Minor or Non-Significant.

   Category D includes any observation that has been evaluated and determined neither to increase the potential for causing or contributing to a human error nor to have adverse safety consequences.

Figure 4-3 includes a branch where HEOs may be reconsidered due to the cumulative or interactive effects of multiple HEOs. Otherwise, HEOs could be discounted as non-significant and dropped out of the assessment and improvement process. Effects of combined category HEOs will be considered during the selection of a correction method. Category D HEOs are optional and will be considered for correction by the Illinois Power Company based on cost-benefit.

3. The next step is to log the HEO/HED. Those observations that are categorized A through C will be assigned an HED number to be logged on a master log sheet (see Figure 4-5). HED numbers will be assigned based upon an alpha-numeric code, with the first digit being keyed to the NUREG-0700, Section 6 topic; i.e., Workspace = 1, Communications = 2, Annunciator = 3, etc. The next letter designates the category (A through D) and the last three digits are assigned in sequence within each of the four categories. All observations classified as HEDs by both the AIT and approved by the Program Manager must be included in the improvement process.

4.2.2 Corrective Actions

The AIT will then review the suggested corrective action noted in each HEO form. Again, the human factors specialist will be available for clarifications, if necessary. The team will then select a correction method. See Figures 4-4, 4-6 and Table 4-3.

1. Selection of Correction Method

   Five possible correction methods are available to the AIT for further action as follows:

   A. Enhancement
   B. Design Change
   C. Design Improvement Study
   D. Operating Procedure Change
   E. Administrative Procedure Change

   To select enhancement when a design change is more appropriate will not be critical. Should either enhancement, design change or improvement study, or a combination of methods prove inadequate or inappropriate, procedure changes may be chosen for correcting or mitigating HEDs.

   During the selection of a correction method, the AIT will consider all correction methods. Where several methods are proposed, the reasons for selecting a particular method will be documented. This documentation will be attached to the basic HEO/HED form.

   While a particular correction method for an individual HED may appear appropriate, an alternative correction method may be more appropriate when the HEDs are grouped. After all HEDs have been analyzed for correction, the AIT will re-evaluate all similar HEDs selected for a particular correction method, to ensure that the method chosen is appropriate and consistent throughout the control room.

HED correction by enhancement, design change, design study, or procedure changes is described below. In each case, analysis will be weighted towards using the judgement of the review team members in developing recommendations. Any special analyses employed in the development of recommendations will be documented and identified by an attachment.

The following approaches will be considered:

A. Enhancement Corrections

Development of enhancements will proceed soon after completion of the selection process, since an enhancement typically provides a significant improvement quickly at low cost. In some cases, the enhancement may be implemented as an interim solution while a long-term design solution is being developed. In this way, the dilemma of providing a near-term solution as well as an integrated control room design in the long-term will be resolved. Figure 4-6 gives some examples of types of enhancements.

B. Design Corrections

Design corrections are those corrections developed through planned design efforts. The AITs responsibilities will be to produce preliminary conceptual design recommendations. The specificity of a recommendation will vary with the type and extent of the HED. A recommendation will specify:

- Problem Statement
- Scope of Work
- Design Objectives

Recommendations will be based on preliminary design analysis performed by the AIT. Analyses may include alternate solution identification, comparison and selection for the case of a simple, isolated HED. Preliminary analysis will provide a preliminary conceptual design requiring further design analyses and engineering.

C. Design Improvement Studies

The correct resolution to some HEDs may require correlation with other HEDs to assure an integrated correction. (For instance labeling, color, type, size, wording, location, etc.) In these instances, a design improvement is the correction method to assure that all parameters are included in the solution, and the AIT will probably recommend that a study be done.

D. Procedure Correction

Changes to existing procedures will be considered as a possible means of correcting an HED. Indeed, the source of the HED may be found in the way the procedure was originally written. Correction of an HED by enhancement or redesign of the panels to conform to a procedure could introduce other potential errors and should therefore be avoided.

Procedure revisions may also be very effective for correcting HEDs where the procedure is not the root cause of the HED. Design limitations may dictate using less than optimal type of control (or placement of a control) to accomplish a particular function, resulting in an HED. Procedures may then be used to compensate for the control's deficiency.

The types of procedure changes chosen to correct or mitigate the effects of an HED may include, but are not limited to:

- o A change in procedure format
- o Improved quality of reproduction
- o Larger or more legible type
- o Inclusion of cautionary statements
- o Re-ordering operator tasks

The AIT will recommend changes to procedures. The actual changes will be made in accordance with Illinois Power Procedures.

All procedure changes will be evaluated according to a verification and validation procedure covering corrective actions.

In general the AIT will determine what recommendations need to be mocked-up and will define the need and method for further verification and/or validation. The mock-up will be very useful for this action.

2. Program Manager Review and Sign-Off

The Program Manager will review each HEO/HED after each HEO/HED has been reviewed by the AIT, with recommendations/revisions and the appropriate priorities and HED numbers assigned. This review will provide management input into the DCRDR and assure overall coordination of the various segments of the corrective actions suggested by the AIT. The senior human factors consultant and principal investigator will be available to assist the Program Manager.

The Program Manager may request clarification, change priorities, categories or implementation schedules.

Any revision to the HEO/HED category will require a new HED number, and will be recorded by the "REV:" entry on the HEO assessment format, with a "1" and the date, indicating that a first revision has been made, etc., and that a new HED number has been assigned. For record purposes, the original HEO/HED will have the new number recorded under the Program Manager Review section, as "See new HED "_____." The original HEO/HED will then be attached to the revised HED, and the "Support Material Attached" box will be checked on the revised HED.

When the Program Manager has finished all discussion/revision of the HED, he will sign and date the form. Implementation of the corrective actions agreed upon then takes place through normal plant change routines.

3. Results

The results of the HEO Assessment and HED Improvement process will be recommendations for changes to the control room design or to the operating procedures intended to reduce the potential for operator error. HEDs recommended for study will be closed out when the implementation study results are complete.

There will be two types of design recommendations. One type will be detailed enhancement correction recommendations for surface treatments requiring limited financial and time resources. The second type will be design correction recommendations for the implementation of a systems engineering design project to develop detailed design corrections; i.e., corrections requiring more significant financial and time resources.

Further studies may result in significant evaluation, analysis, and firm designs to resolve the deficiency prior to implementation.

Where the design approach would be inappropriate for correcting a given HED, recommendations for changes to procedures may be made. These recommendations may include substantive changes in the procedures and/or simple modifications to the format.

Recommendations for improvement will be supported by documents produced throughout the assessment process. This information may be useful in prioritizing implementation of recommendations or to justify a decision not to implement the recommendations.

4.2.3 Documentation

Documentation of the assessment and improvement process will be consistent with procedures and will include records of HEO/HED assessment. The records will be necessary for historical purposes and will be required for subsequent steps in the process; particularly correction method selection.

Correction analysis will be documented in the form of design recommendations, design improvement studies or procedure changes. The recommendations will be supported by engineering drawings, photos, conceptual sketches, calculations or other suitable materials as necessary.

Special emphasis will be placed on documenting justifications not to correct a significant HED and to record dissenting opinions, including the human factors specialist.

TABLE 4-1

CRITERIA FOR EVALUATING HEOs

(MODIFIED FROM NUREG-0801)

Consider the following. Will this HEO:	Probably	Possibly	Not Likely
1. cause undue operator fatigue?	___	___	___
2. cause operator confusion?	___	___	___
3. cause operator discomfort?	___	___	___
4. present a risk of injury to control room personnel?	___	___	___
5. increase the operator's mental workload (for example, by requiring interpolation of values, remembering inconsistent or unconventional control positions, etc.).	___	___	___
6. distract control room personnel from their duties?	___	___	___
7. affect the operator's ability to see or read accurately?	___	___	___
8. affect the operator's ability to hear correctly?	___	___	___

TABLE 4-1 (cont.)

	Probably	Possibly	Not Likely
9. degrade control room personnel performance?	___	___	___
10. degrade the operator's ability to manipulate controls correctly?	___	___	___
11. cause a delay of necessary feedback to the operator?	___	___	___
12. degrade positive feedback about control task(s)?	___	___	___
13. violate control room conventions or practices?	___	___	___
14. violate nuclear industry conventions?	___	___	___
15. violate societal stereotypes?	___	___	___
16. involve highly stressful situations (i.e., highly time constrained, of serious consequences, etc.)?	___	___	___
17. lead to inadvertent activation or de-activation of controls?	___	___	___
18. cause a specific error? Is it probable that another error of equal or more serious consequences will be committed?	___	___	___

TABLE 4-2

HEO PLANT IMPACT EVALUATION CRITERIA

	Probably	Possibly	Not Likely
Does the HEO involve controls or displays that are used by operators while executing emergency procedures?	___	___	___
It is likely that the error caused by this HEO would result in:			
A violation of a technical specification, safety limit, or a limiting condition for operation?	___	___	___
The unavailability of a safety-related system needed to mitigate transients or system needed to safely shut down the plant?	___	___	___
Does this HEO involve controls or displays that are part of an engineered safety function or are associated with a reactor trip function?	___	___	___
Does this HEO involve control or display problems that would not be readily identified or corrected by alarms, interlocks or other instruments?	___	___	___

TABLE 4-3

HEO RESOLUTION CRITERIA

In evaluating how to resolve a given HEO, the AIT will consider the following questions:

	Yes	Possibly	No
1. Is the HEO really a deficiency?	___	___	___
2. Due to its unique nature, does the HEO require further study or assessment?	___	___	___
3. Can the HEO be resolved with paint/tape/label enhancements?	___	___	___
4. Should the HEO be resolved to maintain consistency with control room conventions or standards?	___	___	___
5. Is the HEO part of a larger or generic HEO?	___	___	___
6. Is the HEO so minor that no physical change is needed and the only action required is to establish operator awareness in routine training?	___	___	___
7. Does the recommended fix really address the issue of concern?	___	___	___

TABLE 4-3 (cont.)

	Yes	Possibly	No
8. Is the operator's ability to respond to any plant transient or accident degraded by implementing the recommended change?	___	___	___
9. Are there other, more cost-effective methods to resolve the HEO?	___	___	___
10. Is the HEO in the process of resolution with an existing design change?	___	___	___
11. Could this HEO result in significant plant downtime or personnel injuries?	___	___	___
12. Could resolution of this HEO provide increased operator productivity and morale?	___	___	___
13. Is the recommendation consistent with present control room characteristics and practices?	___	___	___
14. Does the proposed change create any new HEOs?	___	___	___

HUMAN ENGINEERING OBSERVATION ASSESSMENT

OBSERVATION

PLANT ____________ EVALUATOR ____________ HED# ____________

TASK ____________ SIGNATURE ____________ HEO# ____________

CL# ____ CL ITEM# ________ DATE ____________

CL TITLE ____________________ HEO CATEGORY ________

PANEL TITLE ____________________ PANEL # ________

HEO DESCRIPTION

[] SUPPORT MATERIAL ATTACHED

POTENTIAL OPERATOR ERROR(S)

RECOMMENDED REVISION

RECOMMENDED IMPLEMENTATION:

TECHNICAL REVIEW

CHAIRMAN __________ DATE __________

[] Concur.

[] Concur With Comment/Note.

[] Reevaluate & Resubmit For Following Reason:

Comment/Note/Reason: ____________________

MANAGEMENT REVIEW

DATE __________

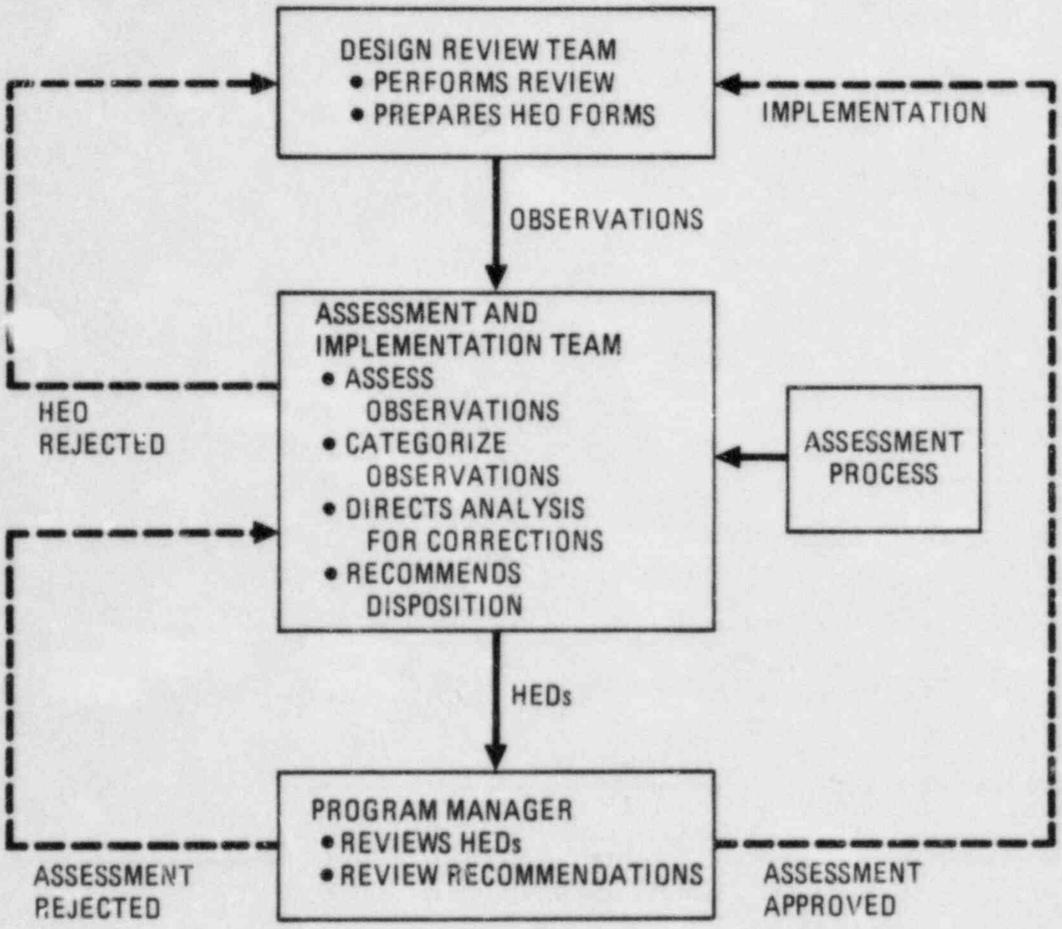
[] Concur.

[] Concur With Comment/Note.

[] Reevaluate & Resubmit For Following Reason:

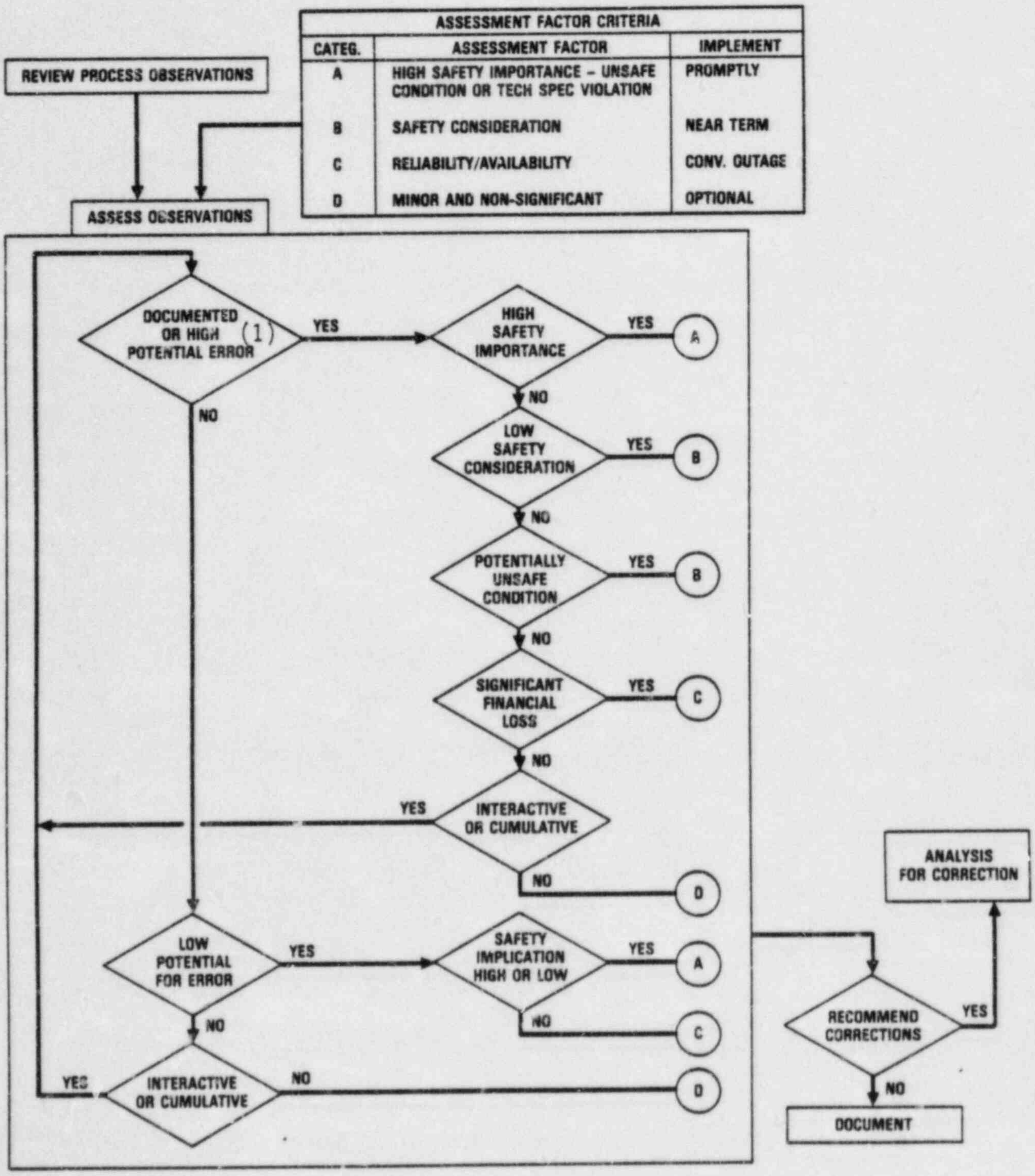
Comment/Note/Reason: ____________________

Figure 4-1. Sample Human Engineering Observation Assessment Form



LEGEND:
HEO – HUMAN ENGINEERING OBSERVATIONS
HED – HUMAN ENGINEERING DISCREPANCY

Figure 4-2. Assessment and Implementation Flow Diagram



ASSESSMENT FACTOR CRITERIA		
CATEG.	ASSESSMENT FACTOR	IMPLEMENT
A	HIGH SAFETY IMPORTANCE - UNSAFE CONDITION OR TECH SPEC VIOLATION	PROMPTLY
B	SAFETY CONSIDERATION	NEAR TERM
C	RELIABILITY/AVAILABILITY	CONV. OUTAGE
D	MINOR AND NON-SIGNIFICANT	OPTIONAL

(1) See Table 4-1 for Criteria

Figure 4-3. HEO Processing

IMAGE EVALUATION TEST TARGET (MT-3)

150mm

6"

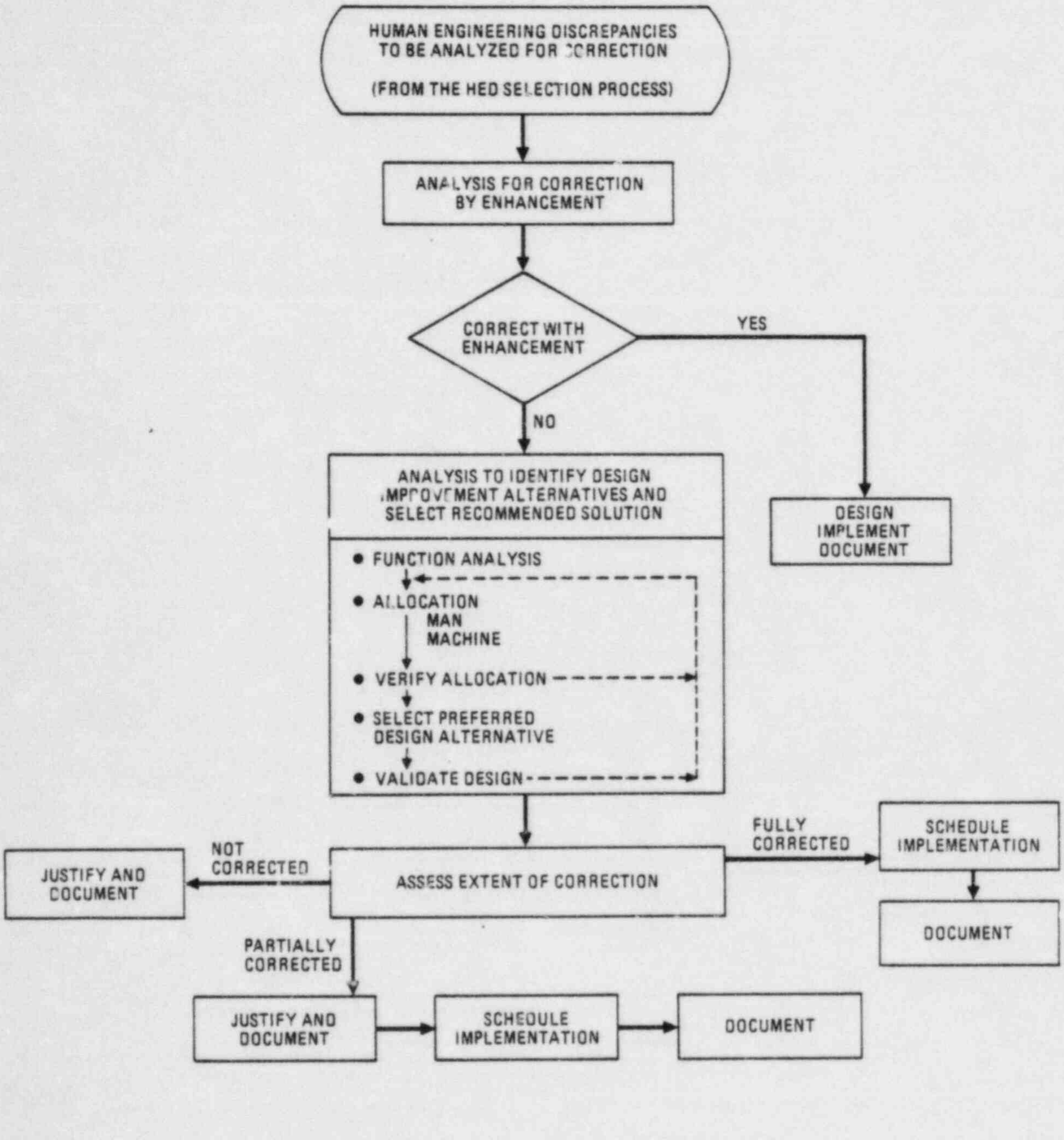


Figure 4-4 Selection of Design Improvements

DCRDR HEO DISPOSITION LOG

HEO	CL ITEMS	BOARD NO.	CATEGORY NO.	COMMENTS

ASSESSMENT TEAM LEADER__________________________ DATE__________ Pg ___ of ___

Figure 4-5 Sample Master Log Sheet

ENHANCEMENT:

DEFINITION -CONTROL ROOM IMPROVEMENT BY SURFACE TREATMENT TECHNIQUES.

ACTION WORDS - ADD, REMOVE, REPLACE, RE-LOCATE, MODIFY, ADJUST, ORGANIZE.

EXAMPLES:

- LABELS:
  - CONTROLS
  - DISPLAYS
  - SYSTEMS
  - FUNCTIONS
  - ANNUNCIATOR TITLES
- DEMARCATION & MIMICS:
  - LINES
  - SYMBOLS
  - ZONES
  - CODING (COLOR, SHAPE, ETC)
- ENVIRONMENT:
  - FURNISHINGS
  - ROOM COLOR(S)
  - CABINET COLOR(S)
  - TEMPERATURE
  - VENTILATION
  - LIGHTING
  - NOISE LEVEL
  - TRAFFIC PATTERN(S)
  - FURNITURE LOCATION
- DISPLAYS:
  - RECORDER PAPER & SCALE
  - INDICATOR SCALES
- PROCEDURES VOLUMES:
  - ORGANIZATION
  - LABELING
  - COLOR CODING
- HARDWARE:
  - HANDLES
  - KNOBS
  - METER FACES

Figure 4-6.
Sample Enhancement Suitability Checklist

5.0 DOCUMENTATION USED TO SUPPORT THE DCRDR

5.1 GENERAL COMMENTS

- o A library has been established to assist the Design Review Team. The documents contained therein are the lastest plant construction documents consistent with Section 2.4.1 of NUREG-0700.

- o A reference library has been established containing pertinent human factors documents including many of those listed in NUREG-0700, as well as relevant documents generated in other DCRDRs and relevant EPRI and INPO documents.

5.2 DOCUMENTATION GENERATED BY THE DCRDR PROCESS

The following basic documents will be submitted to the NRC for approval as part of the DCRDR program:

- o Program Plan Report (this document).
- o Executive Summary Report, which will address methodology, review findings, and implementation.

The following summary reports will be generated in support of the review.

- o Criteria Report
- o OER Report
- o SFTA & Verification and Validation of EOPs Report
- o CRS Report
- o Inventory Report
- o Compilation of Observations & HEDs

The format shown in Figure 5-1 will be considered for the Executive Summary Report.

5.3 DOCUMENTATION SYSTEM AND CONTROL

The human factors consultant will develop a data base which will be reviewed by the Design Review Team. This data base will consist of computerized printouts and hard copy files of cross-referenced information including:

- o Listings of reference plant documents used.
- o Listing of human factors referenced documents used.
- o The program plan report (this document).
- o Pertinent documents defining requirements for the DCRDR.
- o The control room criteria report.
- o The outputs of the individual task groups (see Figure 2-3).
- o Minutes of meetings.
- o All findings, HEDs, and dispositions as processed.
- o Executive Summary Report.
- o Topical DCRDR Reports.
- o Pertinent correspondence.

In addition, a filing system as shown in Appendix D will be developed.

1.0 INTRODUCTION

1.1 General Comments

1.2 Purpose and Objectives

- Describe EOP V&V and DCRDR integration

1.3 Plant Description

1.4 Definition of Control Room

2.0 DCRDR PLANNING, METHODOLOGY

2.1 Planning

- Summarize from program plan.

2.2 Methodology

2.2.1 General

- As required - - -

2.2.2 Criteria Development

- Summary of information, (mainly from criteria report).

- Describe guidelines review

Figure 5-1. Executive Summary Format

2.2.3 Data Base Management System

- Describe use, specific data base and interactions.

- Some information from program plan.

2.2.4 Operating Experience Review

- Summarize information from Operating Experience Review Report.

- Describe interactions with EOP V&V and other DCRDR tasks.

2.2.5 Control Room Survey

- Summarize from Control Room Survey Report.

- Use of mock-up and other facilities.

2.2.6 Control Room Inventory

- Summarize information techniques for preparing Inventory Report.

- Use of mock-up.

- Describe data base record definition.

Figure 5-1. Executive Summary Format (cont.)

2.2.7 EOP & DCRDR Integrated System Function and Task Analysis

- Identify plant systems (per FSAR) covered by EOPs.

- Identify plant systems per basic plant safety function.

- Describe SOE selection criteria and SOEs selected (relationship to EOP V&V program).

- Identify plant system (per FSAR) utilized in SOEs.

- Describe EOP and SOE data collection, data base use and record definition.

- Describe EOP and DCRDR SFTA integration

- Describe data sheets and diagrams (SFTA output) used for analysis, verification and validation:

  - Data sheets ' thru 5.
  - Traffic link diagrams.
  - Operational sequence diagrams.

- Some info from program plan.

- Use of mock-up.

2.2.8 Assessment

Figure 5-1. Executive Summary Format (cont.)

DCRDR RESULTS

3.1 Human Engineering Observation Summary

- Describe HEOs by task, checklist, assessment action and category.

- Show cross-reference to past control room review results.

- Identify separate DCRDR task reports.

3.2 Human Engineering Discrepancy Summary

- Describe HEDs by category.

- Describe significant HEDs.

DCRDR CONCLUSIONS

4.1 HED Corrective Actions and Schedule

- Describe corrective actions to be taken and schedule.

- Describe studies, if any, to be conducted to determine correction action and schedule.

4.2 Remaining Work

- Describe task data base status.

- Describe remaining work for:

  - All DCRDR tasks.
  - Integration plan covering NUREG-0737, Supplement 1.

Figure 5-1. Executive Summary Format (concl.)

6.0 SUMMARY

The Illinois Power Company considers that this program plan for the Detailed Control Room Design Review of the Clinton Power Station Unit 1 is extensive, complete and consistent with the pertinent documents noted herein.

The program is in progress and it is our intention to comply with the content of this program plan. The Illinois Power Company reserves the right to make changes in its best interest and will notify the NRC of all planned or executed deviations as part of its final documentation submittal, or sooner, if necessary.

APPENDIX A

QUALIFICATION OF DESIGN REVIEW TEAM MEMBERS

DOUGLAS M. ANTONELLI
Illinois Power Company
Member of Design Review Team

EDUCATION

Richland Community College A.S. degree

TRAINING

Electronic Technical "A" School, USN (1965)
Nuclear Power Training, USN (1966)
Electronic Technical "B" School, USN (1969)
Brunswick Steam Electric Plant Licensed Training (11/73)
General Physics Corp. Mitigating Reactor Core Damage Training
GE BWR Cold License Certification (2/74)
CPS Licensed Operator Training Program
SPA Training Program

EXPERIENCE

Illinois Power Company (1980 to Present)

Supervisor - Plant Operations, Clinton Power Station

Direct all Operations Department activities including FSAR amendment work, procedure preparation, startup support activities, technical specifications development and design review.

1976 - 1980

Shift Supervisor, Clinton Power Station

Coordinated procedure preparation effort of Operations Dept.

Carolina Power and Light Company (1973 - 1976)

Held the positions of Auxiliary Operator, Control Room Operator, and Operations shift Foreman at the Brunswick Steam and Electric BWR Plant. Experience during this period includes the testing, startup, and commercial operation of the unit. Also assigned to the Training Dept. as instructor for the operator retraining program.

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U.S. Navy (1970 - 1973)

Senior/Leading Reactor Operator at the S5G Naval Nuclear Propulsion Prototype. Duties during this period include supervising a group of Reactor Operators in the maintenance and operation of reactor control equipment and the training of Reactor Operator students.

U.S. Navy (1967 - 1968)

Reactor Operator assigned to the USS Sam Houston, a nuclear submarine. Qualified to stand various engineering watchstations and perform maintenance on electronic, reactor control equipment.

1.5/091584
VAXC/161

WILLIAM R. ARNOLD
Instrumentation and Control Engineer
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Reactor protection and instrumentation systems: design and analysis, operation, startup, trouble shooting, and equipment qualification.

EDUCATION

BSEE, University of Texas, 1958.
Graduate Courses, Electrical and Nuclear Engineering.

EXPERIENCE

Review of control room design for compliance with NUREG-0700 requirements on South Texas Project, Pilgrim, and Indian Point 2. Assisted in revision of layout of control panel devices and annunciators.

Worked on the control room design review for the South Texas Project Nuclear Generating Station. Participated in all phases of the eview including control room survey, system function and task analysis, and annunciator review. Also, participated in subsequent redesign of control panel layouts for this project.

Review of qualification data for safety-related equipment for PWR projects. Responsible for assuring that the data packages met the general requirements of NUREG-0588 and the specific requirements referenced and that the equipment represented is satisfactory for use in a harsh environment.

Review of safety-related plant control and protection system logic and operation to confirm that components important to safety are properly classified for PWR projects at Bechtel.

Field investigation and solution of reactor protection system trips and transients during startup of Fort St. Vrain station. Liaison on operational and licensing aspects with utility operations and with NRC.

Field engineer in successful construction and start-up of all internal and adjacent external reactor instruments, pressure test and hot flow test support, and control rod drive checkout for Fort St. Vrain station.

Completed design and documentation for licensing of reactor plant protection systems. Accomplishments included logic design, cabling, customer liaison and review of specifications and layout for compliance with applicable NRC design criteria.

Electrical design of aerospace launch control hardware and systems.

PROFESSIONAL ASSOCIATIONS

Registered Control Systems Engineer, California, 1975.

RICHARD P. BICHEL
Supervisor
Illinois Power Company
Member of Design Review Team

EDUCATION

BS, Chemical Engineering, University of Michigan 1974
BS, Nuclear Engineering, University of Michigan 1974
MS, Chemical Engineering, University of Michigan 1975

TRAINING

Senior Operator Licensee at Big Rock Point Nuclear Plant, 2/82
Senior Operator Certification - BWR 6 Training Center 6/84

EXPERIENCE

Illinois Power Company (1983 to Present)

Supervisor - Results - Responsible for directing the activities of the Technical Department Results Group in the development of plant testing procedures and equipment monitoring programs.

Consumers Power Company, Midland
Nuclear Power Plant, Midland, Michigan

1983 - 1983

Discipline Supervisor - Responsible for directing the activities of a start-up engineering group for the plant process steam system. Supervisor over procedure development, system checkout, and start-up testing and flushing.

1982 - 1983

Start-up Engineer (Senior Engineer) - Responsible for developing procedures and testing program for process steam system. Also provided direction for system electrical and instrument checkout and system problem resolution.

Consumers Power Company Big Rock Point
Nuclear Plant, Charlevoix, Michigan

1980 - 1982

Shift Technical Advisor/Shift Engineer - Provided on-shift engineering support to the plant operating staff. Worked on evaluation of NRC documents and INPO documents for applicability to plant.

1972 - 1982

QA engineer - Responsible for document review and QA support to the plant staff. Performed surveillances of plant operations (various departments) to verify compliance to requairements

Consumers Power Company, Marysville Gas
Nuclear Plant, Marysville, Michigan

1975 - 1979

Associate Engineer/General Engineer - Project/Process engineering duties including equipment evaluation, capital projects implementation, plant modification development and installation, and limited trouble shooting of plant systems.

PROFESSIONAL ASSOCIATIONS

Registered Professional Engineer - State of Michigan (1979)
American Institute of Chemical Engineers
American Nuclear Society
American Society of Professional Engineers

ERROL P. GAGNON
Nuclear Systems Engineer
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Licensing, safety criteria and technical specification preparation and review.

EDUCATION

B.S., Engineering, San Diego State University, 1965

PROFESSIONAL EXPERIENCE AT GA TECHNOLOGIES INC. (Since 1969)

Currently Assistant Project Engineer for the DCRDR of Pilgrim Station and Clinton Station. Responsible for SFTA, Assessment and Reporting Phases. Consultant for SFTA for the Kewaunee DCRDR Project.

Assisted in the SFTA for the control room design review for the South Texas Project under contract to Bechtel Power Corp.

Chairman of the Results Review Committee of the Human Factors Evaluation program for the Palo Verde Nuclear Power Generating Station control room and responsible for coordination of the program tasks. Performed SFTA and human factors evaluation of the SPDS for Palo Verde.

Developed safety/licensing positions and criteria for various applications of nuclear power plants.

Evaluated nuclear power plant systems and components to identify and prioritize technical, safety and licensing issues.

Developed nuclear power plant transient performance specifications.

Senior Technical Representative at Fort St. Vrain responsible for technical coordination and guidance on the conduct and evaluation of the startup test program.

Manager of the French Licensee Program responsible for the administrative and technical-transfer aspects of the nuclear power plant licensing agreements and contracts.

Performed simulation studies and evaluations of nuclear power plant transient performance/safety analyses, control systems, control room configurations and plant startup procedures.

PROFESSIONAL ASSOCIATIONS/HONORS

Member, American Nuclear Society

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Max J. Hollinden
Results Engineer
Illinois Power Company
Member of Design Review Team

EDUCATION

Purdue University, West LaFayette, Indiana.
Bachelor of Science in Mechanical Engineering Technology.
Graduated May 1982.

University of Illinois, Champaign, Illinois.
Nuclear Engineering Courses, June 1982 - December 1983.

TRAINING

Mitigating Reactor Core Damage Training 1983.
Human Factors Training 1983.
Clinton Power Station Operator Systems Training 1984.
Present: GE Station Nuclear Engineer Training.
Ongoing: Clinton Power Station Shift Technical Advisor Training.

EXPERIENCE

Illinois Power Company (1982 to Present)

Engineer in Technical - Results Section. Major duties include: investigation and recommendations to resolve human engineering discrepancies identified in Preliminary Design Assessment of Main Control Room, scheduling and coordinating plant staff activities, Diesel Generator Reliability Task Force Representative.

PROFESSIONAL ASSOCIATIONS

American Nuclear Society

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MELINDA ANNE KRAUSE
Nuclear Engineer
Illinois Power Company
Member of the Design Review Team

EDUCATION

B.S. Nuclear Engineering, 1983 Univeristy of Illinois

TRAINING

GE Probabilistic Risk Assessment, 1983
Mitigating Reactor Core Damage, 1982
Clinton Power Station (CPS) Systems Training, 1984

EXPERIENCE

Illinois Power Company (June 1983 to Present)

Technical Staff Engineer
Responsible for revisions to plant-specific emergency procedures guidelines and emergency operating procedures. Responsible for coordination of plant staff FSAR revisions.

June 1982 to August 1982

Nuclear Station Engineering Department
(Summer student) - Fuels section

June 1981 to August 1981

Technical Staff Engineer
Responsible for revisions to plant-specific emergency procedures guidelines and emergency operating procedures. Responsible for coordination of plant staff FSAR revisions.

June 1982 to August 1982

Technical Staff
(Summer student) Responsible for calculation of evacuation time estimates for CPS Emergency Plan.

EXPERIENCE

June 1979 to August 1979

Member of cable tray installation crew (summer student).

PROFESSIONAL ASSOCIATIONS

American Nuclear Society - associate member

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SAL F. LUNA
Project Engineer
Sr. Human Factors Specialist
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Design and development, instrumentation and control; human factors

EDUCATION

B.S., Chemistry, Magna Cum Laude, Niagara University, 1947
Specialty courses: Seismic - Wyle Labs, Human Factors - University of Tennessee and Electric Power Research Institute.

EXPERIENCE

Project Engineer responsible for NUREG-0700 type design review of the South Texas Project, Pilgrim, Indian Point #2, Kewaunee and Clinton control rooms. Prepared program plan for Rancho Seco.

Project Engineer responsible for Human Factors review of Palo Verde Nuclear Generating Station control rooms. Performed Annunciator Prioritization Study for same.

Directed design of advanced control room control consoles and unitized cabinets including: human factors engineering, full scale mock-ups, modular construction and seismic qualification.

Project Engineer responsible for Probabilistic Risk Assessment Study for Fire Protection Program Assessment of Northeast Utilities Nuclear Plants - Connecticut Yankee, Millstone 1, and Millstone 2.

Consultant, review of PG&E equipment qualification documents for NRC approval. Developed formats and organized walkdown teams for PP&L equipment qualification program.

Design of a wide variety of systems for advanced HTGR plants. Special studies for application of all technology for modernizing existing nuclear power plants featuring a "Diagnostic Console."

Directed development of in-core and ex-core instrumentation to study Fort St. Vrain core fluctuation phenomena.

Directed site engineering and craft effort to provide fire protection of critical Fort St. Vrain cabling.

Prepared specifications, designed special testing equipment conducted qualification tests, evaluated results and prepared reports for cabling and instrumentation for Fort St. Vrain equipment qualification program.

EXPERIENCE (Continued)

Managed a wide variety of instrumentational control and development groups at Westinghouse Electric Corp. for the nuclear navy and commercial nuclear programs. Cognizant engineer for Annunciator Systems for same.

Directed the design and development of a wide variety of processing plant instrumentation systems for Catalytic Construction Co.

PUBLICATIONS

Editor of Cassette Control Valve Training Program.
Author of chapter on Maintenance - ISA Control Valve Handbook.
Author of chapter on Liquid Level Measurement - ISA publication.
Also authored a wide variety of technical papers including methodology and results of human factors review of Palo Verde, and advanced control room design.

PROFESSIONAL ASSOCIATIONS

Registered Professional Engineer (control) California
Fellow Grade Member of ISA
Past Vice President Long Range Planning Department of ISA
Nuclear Power Plant Standards Committee of ISA
Member Human Factors Society

JOHN P. O'BRIEN
Illinois Power Company
Member of Design Review Team

EDUCATION

B.S.E.E. Iowa State University
M.S.N.E. University of Illinois

EXPERIENCE

Illinois Power Company (1976 - Present)

Supervisor - Instrumentation & Controls Engineering, Nuclear Station Engineering Department

Supervision of control and instrumentation design preparation and review.

1968 - 1976

Supervisor of Systems and Programming - Engineering, Data Processing Department

Supervision of computer programming on application of an engineering or scientific nature.

1967 - 1968

Senior Engineering Systems Programmer, Data Processing Department

Engaged in computer program development of an engineering or scientific nature.

1964 - 1967

Electrical engineer - Computer Engineering Department

Involved in computer program development, installation and processing for the Engineering Department

1960 - 1964

Engineer, Engineering Department

Involved in generation and transmission planning related to capacity additions.

RICHARD C. POTTER
Nuclear Systems Engineer
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Power plant dynamic and steady-state systems design and analysis including large scale systems simulation.

EDUCATION

B.S., Mechanical Engineering, University of Minnesota
M.S., Mechanical Engineering, University of Southern California

EXPERIENCE

Presently Assistant Project Engineer for the DCRDR of Kewaunee. Responsible for operating experience review, SFTA and documentation. Assisted in the SFTA for the Palo Verde Nuclear Generating Station. He recently completed an assignment as Assistant Project Engineer on the control room design review of the South Texas Project where he performed system functions and task analysis, performed a control room survey, developed program plans and directed other engineers during the review.

Mr. Potter was responsible for a fire vulnerability study of three Northeast Utilities nuclear power plants. Study involved the use of probabilistic risk assessment techniques for predicting the shutdown capability of these plants in the event of a fire.

He also participated in a probabilistic risk assessment of the Fort St. Vrain plant to determine clean up costs versus probability for on-site contamination due to an interruption of cooling event.

On the Fort St. Vrain Nuclear Generating Station project responsible for: modifying and maintaining computer models for the simulation of steady-state and transient plant performance review which included data monitoring and analysis as required to ensure proper plant operation; and performing steady-state and dynamic analysis to support the plant startup testing program.

While assigned to the Gas Cooled Fast Reactor Project he performed a conceptual analysis of a natural convection, drum-type and condenser-type shutdown cooling system.

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EXPERIENCE (Continued)

On the HTGR nuclear project he was responsible for the following: modifying and maintaining the steady-state and transient plant performance programs, the pipe rupture analysis program and the core afterheat analysis program; predicting power plant nominal, shutdown and refueling performance for use by design and analysis groups within the company and for use by the customers and performing parametric and application studies relating to the overall plant design and performance.

Prior to joining Torrey Pines Technology, he directed activities involving propulsion analyses, application studies and computer simulation work on large liquid rocket engines. He has also worked as a design engineer responsible for design and detailing of ground support equipment for rockets.

PROFESSIONAL ASSOCIATIONS

Professional Mechanical Engineer in State of California
Member of the American Society of Mechanical Engineers
Member of Pi Tau Sigma

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JOHN R. PATTEN
Illinois Power Company
Member of Design Review Team

EDUCATION

B.S., U.S. Navel Academy, 1959
M.B.A., University of New Haven, 1982

TRAINING

U.S. Navy Nuclear Power Training, 1963-64
CPS Licensed Operator Training Program

EXPERIENCE

Illinois Power Company (1983 - Present)

Director - Nuclear Training
Supervise staff of nine instructors in conducting training for plant staff personnel, including licensed and non-licensed operators and monitoring and approving training conducted by other plant staff departments. Supervise preparation of and approve lesson plans and training material. Subject material includes fundamentals, NSSS, BOP and system familiarization

U.S. Navy active duty (1959 - 1983)

Executive Officer, Naval Submarine Support Facility, New London, CT.

Managed maintenance and repairs for two squadrons of nuclear submarines, including radiological controls, processing and shipment of radwaste, photodosimetry, QA and NDT.

1977 - 1980

Director of Officer Training, U.S. Naval Submarine School

Supervised training of over 1200 students per year in thirty courses of instruction ranging in length from a few days to six months.

1973 - 1977

Commanding Officer, USS George C. Marshall (SSBN 654) (Blue)

Complete and total responsibility for operation and maintenance of strategic missile submarine including nuclear propulsion plant. Responsible for training and performance of crew. Completed six highly successful deterrent patrols and pre-patrol upkeep periods.

1964 - 1970

Various assignments on four submarines and one shore command, including one refueling overhaul, initial criticality, startup test program and one training assignment.

1963 - 1964

U.S. Navy nuclear power training.

1959 - 1963

Various junior officer assignments on surface ship and diesel-electric submarine.

TERRY L. RILEY
Illinois Power Company
Member of the Design Review Team

EDUCATION

Univeristy of Illinois, Champaign-Urbana, Bachelor of Science in Astronomy. Graduated May 1977.

EXPERIENCE

Illinois Power Company (1981 to Present)

Nuclear Satation Engineering Department Staff Specialist
Job assignments/responsibilities include:

1. Technical resolustion of NRC Licensing Issues regarding Control Room post-accident radiation doses, Control Room Design Reviews, Plant Emergency Operating Procedures, design and operation of Plant Emergency Response Facilities.
2. Detailed review and development of Plant Emergency Operating Procedures.
3. Conceptual design and development of computerized Safety Parameter Display System for the Main Control Room. Evaluation of Plant Physical response to a complete loss of all AC Power event (Station Blackout).
4. Evaluation of Reactor Vessel Water Level Measurement System.

General Electric Company (March 1980 - December 1981)

Career development highlights involved the GE Naval Nuclear Operations Program and included:

1. Nuclear Power Engineering School at KAPL (22 weeks) - Operations Egnineer in training. Received training in Naval Nuclear Plant technical theory and operations fundamentals.
2. S1C Windsor Site (Prototype) Operations, Windsor, Connecticut (6 months) - Engineering Officer of the Watch (EOOW) in training.
3. S1C Windsor Site Operations (10 months) - Nuclear Plant Engineer for Training. Served as a member of shift staff with daily activities and responsibilities that included Naval section training, personnel counseling, and standing EOOW watches.

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RAYMOND SABEH
Human Factors Specialist
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Human Factors Engineering, Operations Research Analysis

EDUCATION

PH.D., (candidate), Experimental Psychology, Ohio State University
M.A., Industrial Psychology, Ohio University
B.A., General Psychology, Davis and Elkins College

EXPERIENCE

Responsible for developing and conducting the Operations Personnel Questionnaire, the Interviews and the Control Room Survey to conform with NUREG-0700 Guidelines for the Pilgrim, Kewaunee, Indian Point #2 and Clinton Nuclear Stations.

Responsible for Human Factors review of corrective enhancements, hierarchical labeling, and demarcation for the South Texas Project.

Responsible for special studies and operations personnel validation via operator questionnaire interview evaluations for the Palo Verde Plants. In addition, responsible for conducting a Human Factors review of the Palo Verde Safety Parameters Display System in conformance with NUREG-0700 and NUREG-0835.

Responsible for preparing and implementing the human factors portion of the NUREG-0700 plan for three NU nuclear operating plants and a fourth NTOL plant. Served as the human factors team member on the NU Safety Parameter Display System (SPDS) program that will be designed, developed, and implemented for as consortium of some 10 separate utility plants. Prepared Human Factors Engineering Orientation Course material used for instructing nuclear engineers and reactor operators.

Northeast Utilities - served as project leader and carried out nuclear operations analysis assignments concerning nuclear regulatory requirements to conduct human factors study analysis and review of all activities affecting man-machine power plant design and operation. In this capacity was appointed as subcommittee chairman to technically monitor and direct the Westinghouse Corporation's efforts for developing a generic system function and task analysis on their PWR plants under contract to Westinghouse Owner's Group.

Consultant - responsible for human factors design of a control center for the storage and retrieval of nuclear waste.

EXPERIENCE (Continued)

Manager/man-machine analysis branch at the Naval Electronics Laboratory - performed human engineering analysis of the Automated Record Data System for the E4A Aircraft. Also performed a man-machine analysis of the FFGX-CIC space and work place design for SEAMOD, a ship-shore communications effectiveness study. Designed the operator interface for the Minimum Essential Emergency Communications Network Message Processing Mode including the development of computer simulation techniques to assess alternate operator interface designs.

Engineering Psychologist - initiated and coordinated research in development of methods and techniques used in human factors engineering system design and development. Technical leader of a communications effectiveness study effort and shipboard habitability programs.

Planned and technically directed the National Military Command System, the Emergency Action Room and World-Wide airborne command post studies for the Defense Communications Agency.

PROFESSIONAL ASSOCIATIONS

American Nuclear Society
Human Factors Society
Operations Research Society of American
National Academy of Sciences Armed Forces-NTD Committee on Vision
Southwest Regional Director, Society for Information Displays

PUBLICATIONS

Review of the Safety Parameters Display System for Palo Verde, Torrey Pines Technology, GA-C17368, November 1983.

Human Factor Review of the Palo Verde ERFDADS Terminal CRT Display and the ESFAS Annunciator Window Box, Torrey Pines Technology, GA-C17154, June 1983.

Control Room Operator Personnel Survey for Palo Verde Nuclear Generating Station, Torrey Pines Technology, GA-C17155, June 1983.

Human Factors Review of the Foxboro 250 Series Indicators and Controllers for Palo Verde, Torrey Pines Technology GA-C17072, May 1983.

Human Factors Engineering Orientation, Northeast Utilities, October, 1982.

FRANK P. SCALETTA
Senior Engineer
Torrey Pines Technology
Member of Design Review Team

PROFESSIONAL SPECIALTY

Safety, reliability, maintainability of nuclear plant mechanical systems and equipment.

EDUCATION

B.S., Math/Physics, University of Chicago, 1950.

EXPERIENCE

Performed control room inventory for Pilgrim and Indian Point #2 DCRDR. Prepared traffic link diagrams for Pilgrim SFTA.

Previously involved in updating the San Onofre Nuclear Generating Stations Units 2 & 3 FSAR for Bechtel.

Performed systems analysis work in support of TVA's PRA study for Brown's Ferry.

Reliability/safety studies of a gas-cooled reactor's Nuclear Steam System and BOP System including FMEA and fault/event trees; data evaluation; low probability events; fire; unplanned releases; design reviews.

Performed Ship System R/M/A analyses; FMEA's data evaluations; proposal preparation; liaison on FDLS, LHA, D.G. programs.

Provided Mission/Vehicle/Systems/Component Reliability analysis; design reviews; system analyses; proposals on space launch vehicles and boosters.

Aircraft Nuclear Propulsion - Prediction of material, component, or system behavior in a nuclear aircraft environment; recommend corrective actions; radiation testing; develop predictive techniques; conduct tradeoff studies. Engineering Test Lab - Qualification testing of B-36 and B-58 Aircraft Hydraulic, pneumatic, mechanical, and optical components; design/build test fixtures; instrument design and installation.

Performed Reliability Analyses of Saturn Space Booster Components and Systems.

PROFESSIONAL ASSOCIATIONS

Certified Reliability Engineer
Member, ANS and ASQC

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ERIC A. SCHWEITZER
Illinois Power Company
Member of Design Review Team

EDUCATION

B.S. Engineering Physics, University of Illinois, 1973
M.S. Nuclear Engineering, University of Illinois, 1974

TRAINING

CPS Licensed Operators Training Program
General Electric Probabilistic Risk Assessment Training
General Physics Corp.
Mitigating Reactor Core Damage Training

EXPERIENCE

Illinois Power Company (1977 - Present)

Nuclear Engineer, Supervisor - Nuclear at Clinton Power Station

Prepared Techical Dept. administrative and nuclear engineering procedures. Evaluate industry experience for CPS applicability. Special nuclear material custodian. Prepared the nuclear engineering program.

Commonwealth Edison Co., Quad Cities Power Station (1974 - 1977)

Nuclear Engineer

Duties included reactor performance monitoring and calculations to assure conformance with Technical Specifications, fuel performance limits and the optimum power distribution. Implemented control rod patterns consistent with normal operation and xenon transients. Prepared fuel moves for refueling operations and participated in post refueling testing.

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THERESA A. SGAMMATO
Systems Engineer
Member of Design Review Team

EDUCATION

B.S., Mechanical Engineering, Columbia University, School of Engineering and Applied Science, New York, NY, 1984

EXPERIENCE

GA Technologies, San Diego, CA
Assisted in the DCRDR of Kewaunee Nuclear Plant.
Identified instrument/control requirements and characteristics independent of existing control room instrumentation. Reviewed SFTA data.

Consolidated Edison, Indian Point Unit 2 Nuclear Power Station, Buchanan, NY.
Operated the Water Demineralization Facility. Purified make-up water for primary and secondary cooling systems. Tested and monitored water chemistry. Maintained and regenerated ion exchange resin beds.

PROFESSIONAL ASSOCIATIONS

Member of the American Society of Mechanical Engineers.

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PAUL JOHN TELTHORST
Results Project Engineer
Illinois Power Company
Member of Design Review Team

EDUCATION

University of Missouri-Rolla, Rolla, Missouri.
Bachelor of Science in Mechanical Engineering. Graduated 1976.

EXPERIENCE

Illinois Power Company (1982 to Present)

Clinton Power Station Technical Staff Results Engineer. Promoted to Results Project Engineer in September 1983. Temporarily assigned as the Emergency Response Capability Implementation Plan (ERCIP) Project Manager from March 1983 to April 1984 by the Vice President (Nuclear) to write the plan (ERCIP) and implement the program to respond to NRC Generic Letter 82-33, Supplement 1 to NUREG-0737.

U.S. Navy (1981 - 1982)

USS Hammerhead (SSN 663)
Weapons Officer in charge of 2 officers and 25 personnel in the Weapons Department. Responsibilities include: supervision of opreation, maintenance, and training of all sonar, fire control, weapons delivery, and security systems; administration and management of personnel; procurement of supplies and repair parts.

1981

Electrical Officer in charge of 13 personnel in Electrical Division. Responsible for operation and performance of preventive and corrective maintenance of all shipboard electrical generation and distribution equipment.
Qualified Engineer Officer. (Engineers Exam at Naval Reactors)

1979 - 1981

Main Propulsion Assistant in charge of 16 personnel in Machinery Division. Responsible for maintenance and operation of the ship's main propulsion system and auxiliary equipment.
Qualified as Officer of the Deck and in Submarines.

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1978 - 1979

Chemistry and Radiological Controls Assistant in charge of 5 personnel. Responsible for monitoring primary and secondary plant chemistry and monitoring the radiological controls associated with the nuclear power plant.
Electrical officer in charge of 12 in Electrical Division.
Qualified as Engineerinng Officer of the Watch.

PROFESSIONAL ASSOCIATIONS

American Nuclear Society
American Society of Mechanical Engineers

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E. L. (RETT) CONSIDINE

EDUCATION

U. S. Naval Schools
Electronic Technician "A", Treasure Island, CA
Submarine School, New London, CN
U. S. Naval Nuclear Power School, More Island, CA
Nuclear Power Training Unit, Idaho Falls, ID

SUMMARY

Present: Staff Engineering Specialist responsible for control room evaluations and improvements.

2 Years: Staff Engineering Specialist responsible to the South Texas Project for development and implementation of the Control Room Design Review per NUREG 0700.

4 Years: Engineering Group Supervisor responsible for directing the Control Systems Discipline on the R. S. Nelson Project, a 650 MW coal-fired power plant.

1 Year: Control Systems Specialist assigned to the Sayago project in Spain responsible for development of criteria for: control room, computer, and the total interaction of the control systems on the project.

1/2 Year: Control Systems Supervisor on a seawater pipeline responsible for the coordinated implementation of sixteen interacting control rooms. Responsiblities included all analog instrumentation and control logics.

1 Year: Engineering Group Leader responsible for the control room design and the control systems integration of the Nuclear Steam Supply System contract.

2 Years: Proposal and Preliminary Safety Analysis Report technical support for domestic and international efforts. Conceptual design of several nuclear unit control rooms.

1 Year: Startup field liaison during computer modification at Southern California Edison's Alametos and Huntington Beach Generating Station.

8 Years: Reactor Operations, pressurized water reactors.

EXPERIENCE

Twenty years experience in engineering design and operation of nuclear and fossil fueled power plants. Currently on the Chief Control System Engineer's Staff working in the Control Room Evaluation and Improvement area. Presently working on; Boston Edison - Pilgrim Station; Illinois Power - Clinton Station; and Houston Lighting and Power - South Texas Project. Developed and implemented techniques for reducing the number of meters in the control room, control panel demarcation, hierarchical labeling and meter scales that are acceptable the the NRC.

Engineering Group Supervisor on the R. S. Nelson Project responsible for directing the Control Systems Discipline. Supervised the group's work to assure conformance with applicable codes and good engineering practice; and assured that engineering, design, drafting and procurement proceeded on schedule. Made major decisons relating to the group's design and reported all major developments.

Control Systems Specialist assigned to the Sayago Project in Bilbao, Spain working as a member of the Utilities organization. Responsible for the criteria development for the control room, control room system interface, computer, and annunciators.

In the past several years has contributed to several Bechtel Power Corporation control room studies for the Thermal Power Organization and specific projects. Designed input to the following projects' control room design:

- San Onofre Units 2 & 3, California, USA
- Lemoniz, Bilbao, Spain
- ASCO, Madrid, Spain
- A. W. Vogtle, Georgia, USA
- R. S. Nelson, Unit 6 Coal-Fueled, Louisiana, USA
- Fayette Power Project, 2 Unit Coal-Fired, Texas, USA
- Sayago, Bilbao, Spain
- W. A. Parish, 2 Unit Coal-Fired, Texas, USA
- Vandellos Nuclear Center, Unit 2, Madrid, Spain
- South Texas Project, Bay City, Texas, USA

Previously, qualified as a Senior Reactor Operator, and Chief Reactor Technician on Naval Reactors. As Chief Reactor technician supervised reactor operators and technicians. Responsible for supervising maintenance of the reactor control, protection systems and all instrumentation. Also served as Senior Reactor Control Instructor and was a member of the reactor operator qualification board.

PROFESSIONAL AFFILIATIONS

Member, American Nuclear Society, South Texas Section
Member, Instrument Society of America
Member, Human Factor Society

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APPENDIX B
Sample Procedure

REVIEWED BY ______________________ Project Engineer/Date

APPROVED BY ______________________ Program Manager/Date

1.0 PURPOSE

This procedure defines the method and the requirements for performing the Validation phase of the Emergency Operating Procedures (EOPs) and the Detailed Control Room Design Review (DCRDR).

2.0 APPLICABILITY

This procedure applies to all Design Review Team members, Torrey Pines Technology employees and Illinois Power Company employees participating in the validation phase of the DCRDR.

3.0 REFERENCES

3.1 Clinton Power Station Detailed Control Room Design Review - Program Plan Report Dated September 1984.

3.2 Torrey Pines Technology proposal number GACP 41-212.

3.3 Guidelines for Control Room Design Reviews, NUREG-0700 Dated September 1981.

4.0 DISTRIBUTION

DCRDR Procedure Distribution

5.0 RESPONSIBILITIES

5.1 The DCRDR Program Manager will be responsible for approval of this procedure and changes thereto.

5.2 The DCRDR Project Engineer will be responsible for the review and implementation of this procedure.

6.0 REQUIREMENTS

6.1 Objective

The objective of the validation task is to determine if the functions allocated to the control room operating crew can be accomplished effectively within the control room physical and organizational design. The validation will determine if adequate manual controls, automatic controls, monitoring systems and trained operators are available to ensure safe plant operation within acceptable operating boundaries.

The validation process will provide an opportunity to identify any new Human Engineering Observations (HEOs) that were not discovered in the other phases of the DCRDR. Also, during the validation, pertinant HEOs identified in the other phases of the DCRDR will be evaluated with regards to potential problems relating to real-time control room operation.

6.2 Approach

The validation will be performed by having control room personnel walk and talk through selected event sequences studied in the System Function and Task Analysis (SFTA). The walk and talk throughs will be performed in the control room simulator using real-time simulation of the selected event sequences. The participating operators will perform their normal control room duties for the defined events. They will also describe their actions including name of the control/displays used, the expected value or response and what action to take if expected response does not occur.

A video and audio tape recording will be made of the walk and talk throughs for later analysis. A debriefing session will be held with the operators where the video tape is played back and any additional information or questions will be discussed.

6.3 Validation Tasks

The overall Control Room Validation effort includes the following activities:

a) Review of the SFTA results to select the event sequences to be followed in the walk and talk through.

b) Review of HEOs from the Control Room Survey, the SFTA and the Operating Experience Review to identify particular step sequences for close monitoring during the walk and talk through.

c) Prior to the Real Time Simulation Exercises, a briefing of the operators on the objectives of the exercises and how they will be performed.

d) Performing the Real Time Simulation Exercises of the selected event sequences.

e) Video (including audio) taping of the exercises.

f) A de-briefing of the results including a review of the video tape.

g) Preparation of HEOs resulting from the Real Time Simulation Exercises.

h) Documentation of the overall validation effort including HEOs as a report section to be included as part of the final SFTA report.

6.4 Validation Methodology

The following describes the approach that will be used in performing the validation tasks listed in Section 6.3.

6.4.1 Selection of Event Sequence

As part of the SFTA phase of the DCRDR a review was performed to establish that the selected operational events (SOEs) analyzed in the SFTA were comprehensive events involving all the systems and safety functions. The information used in performing the review was obtained from the Emergency Procedure Guidelines (EPGs). To determine the event sequences to walk through for the validation, the information used in the selection of the SOEs will be reviewed. Several SOEs will be selected for the exercises. The events will be selected to provide a validation of all of the major plant systems and all the control room safety functions identified in the EPGs.

6.4.2 HEO Review

Prior to performing the exercises, a checklist will be prepared which will identify particular step sequences, tasks or devices on the control panels that are considered potential areas of concern. The results and the HEOs from the other phases of the DCRDR (the SFTA, the Survey and the Operating Experience Review) will be reviewed to identify these potential problem areas. In identifying these areas, emphasis will be placed on the controls/displays used in the evaluation of plant status and the diagnosis of the emergency condition.

6.4.3 Operator Briefing

Prior to performing the exercises, a introductory briefing session will be held with the plant operators and the operator of the control room simulator. Following is the contents for this briefing:

a) A brief introduction describing the DCRDR effort and the SFTA phase of this effort.

b) An introduction to the validation effort presenting the purpose and specific objectives of the exercises.

c) A discussion on the method for performing the walk and talk through exercises. A review of the required operator responses discussed in Section 6.4.4 and discussion of significant HEOs or problem areas. A review to determine if a "dry run" walk-through is necessary prior to the real-time walk-through.

d) A discussion on the best method for recording the operator actions on video tape.

6.4.4 Walk and Talk through Exercises

The participating control room operators will perform a walk and talk through of each of the selected event sequences. These exercises will be performed in real-time using the Clinton Power Station control room simulator. The duties or actions that will be performed by the operators will be those described in the latest EPG based Emergency Operating Procedures (EOPs). At least one control room reviewer will be present and the entire walk-through will be recorded on video/audio tape as described in Section 6.4.5.

The operators will be instructed to describe the actions they are performing and the reason for these actions as follows:

a) For an instrument or display, the name of the instrument or parameter that is being monitored and the expected value, status or trend (e.g. reading a reactor coolant temperature value of 450°F).

b) For a control device, the name of the control and the expected action or setting for the control.

c) As time permits, the operator(s) will indicate what actions are performed to verify a reading or system status, i.e. whenever the annunciator panel can be used to verify status or a second display can be observed to verify a reading.

d) As time permits, the operator will describe alternate actions if the expected response or status does not occur (e.g. verifying that one RHR pump is operating via a red status light or switch pump on, if status light were green).

Since the walk-through will be performed in real-time, items (c) and (d) above may be difficult to perform. In most cases, these items can be addressed during the video replay described in Section 6.4.6.

The control room reviewer may ask questions during the exercises, however, these should not interfere with the real-time simulation of the event. Many of these questions can be answered in the de-briefing session or during the "dry run."

6.4.5 Video Recording

The exercises will be recorded on audio/video tape to permit post exercise analysis. A single camera with zooming capability will be used to record the operator actions. The camera should have provisions for a digital time display superimposed on the video image. The camera will be placed in an area in the control room that provides the best view of the panels and equipment involved in each event. If possible, the camera support should be mounted on wheels to allow some movement of the camera if required to improve coverage of the operator actions.

The video recording of each event will begin with an identification or title chart that includes the name of the event, participants, time and place of recording. Audio pickups will be placed so that all pertinent alarms, sounds and operator communication will be audible on playback on the audio recording. An experienced operator or training personnel will act as narrator for each event. The narrator will provide by audio input an overview of the event and the operator actions while being careful not to interfere with the recording of the operator communications.

The video cassettes will be labeled with the name of the review, the event name and the date and time of recording.

6.4.6 Video Debriefing

As a follow-up to the exercise, a debriefing session will be held with the participating operators. The video recordings will be played back and each event will be discussed. The related human engineering criteria will be reviewed and discussed prior to replaying the video tapes.

The purpose of the debriefing is to provide an opportunity for the review team to analyze the operator actions and to ask questions about these actions without being constrained by the real-time operation of the simulator. The video can be stopped during discussions and critical scenes can be replayed if closer review is required.

The debriefing also provides an opportunity for an objective review by the operators of their movement and actions while performing the control room functions.

6.4.7 HEO Preparation

Any violations of the pertinent human engineering guidelines identified during the validation will be recorded as HEOs using form DCRDR-HEO-2 according to procedure DCRDR 5.3-1.

6.4.8 Documentation

The validation effort shall be documented as part of the SFTA report. The results from all the tasks listed in Section 6.3 will be presented and discussed.

7.0 EFFECTIVE DATE

This procedure becomes effective immediately upon approval.

APPENDIX C

Samples from Questionnaire

TABLE OF CONTENTS

A. WORK SPACE AND ENVIRONMENT

1. Do you have any difficulty locating systems, subsystems, or functional groupings of panel equipment?

   ( ) No ( ) Yes (explain) ____________________

2. Do you have any difficulty locating individual devices within a system, subsystem, or functional grouping?

   ( ) No ( ) Yes (explain) ____________________

3. Do you have any difficulty reading display devices?

   ( ) No ( ) Yes (explain) ____________________

4. Do you have any difficulty operating controls?

   ( ) No ( ) Yes (explain) ____________________

CONTROL ROOM EQUIPMENT AND STORAGE (cont.)

5. Are you able to perform your control room functions while dressed in emergency protective equipment?

( ) Yes ( ) No (explain) ____________________
____
____
____

6. Is there adequate document and storage space available?

( ) Yes ( ) No (explain) ____________________
____
____
____

7. Is there adequate storage space within the control room for spare parts, expendables, etc.?

( ) Yes ( ) No (explain) ____________________
____
____
____

8. Is the spare parts and expendables location readily accessible to control room personnel?

( ) Yes ( ) No (explain) ____________________
____
____
____

APPENDIX D

Sample Filing Index

CLINTON POWER STATION - DCRDR

FILING INDEX

ISSUE #	ISSUE DATE
Rev. 0	8/27/84

2.3/8/30/84
vaxc/#97

FILING SYSTEM INDEX

1.0 GENERAL

- 1.1 Communications for Initiating DCRDR Program
  - 1.1.1 Correspondence
  - 1.1.2 Meeting or Conference Minutes
  - 1.1.3 Telecons
- 1.2 Basic Vendor Bid Package and Related Correspondence
- 1.3 Vendor Proposals and Related Correspondence
- 1.4 Bid Evaluations and Related Correspondence
- 1.5 Signed Contract
  - 1.5.1 Contract Revision No. 1 and Related Correspondence
  - 1.5.2 Contract Revision No. 2 and Related Correspondence
  - 1.5.3
  - 1.5.4
  - 1.5.5
  - 1.5.6
- 1.6 Contract Invoices
- 1.7 Program Plan
  - 1.7.1 Correspondence
  - 1.7.2 Meeting or Conference Minutes
  - 1.7.3 Telecons
  - 1.7.4 Program Plan (Each Major Draft with Review Comments) and Approved Revisions
- 1.8 Schedules
  - 1.8.1 Contract Schedule
  - 1.8.2 Working Schedule
- 1.9 Progress Reports
  - 1.9.1 Telecons
  - 1.9.2 Monthly Progress Letters
- 1.10 Program Communications
  - 1.10.1 Correspondence
  - 1.10.2 Conference Notes
  - 1.10.3 Telecons
- 1.11 Internal Correspondence

2.0 ADMINISTRATION

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vaxc/#97

3.0 MOSAIC/MOCKUP

3.1 Communications

3.1.1 Correspondence

3.1.2 Meeting Minutes

3.1.3 Telecons

3.2 Purchase Order

3.2.1 RFP

3.2.2 Response to RFP

3.2.3 Purchase Order and Change Notices

3.3 Installation and Shipping

3.4 Design Changes or Modifications

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4.0 REVIEW

4.1 Operating Experience Review

4.1.1 Correspondence

4.1.2 Team Meetings and Conference Minutes

4.1.3 Telecons

4.1.4 Guidelines and Procedures

4.1.5 Forms (Questionnaire and Interview Drafts with Review Comments)

4.1.6 Raw Data for Plant Experience Document Reviews, Questionnaire Responses and Interview Reponses

4.1.7 Evaluations, Summaries or Reports (Each Major Draft with Review Comments)

4.1.8 HEOs

4.1.9 Graphic Arts Material

4.2 System Function and Task Analysis (Including Verification and Validation)

4.2.1 Correspondence

4.2.2 Team Meeting and Conference Minutes

4.2.3 Telecons

4.2.4 Guidelines and Procedures

4.2.5 Blank Forms

4.2.6 Work Sheets and Completed Forms

4.2.7 Verification Results (Worksheets and Completed Forms)

4.2.8 Validation Results (Worksheets and Completed Forms)

4.2.8.1 Video Tapes

4.2.9 Evaluations, Summaries or Reports (Each Major Draft with Review Comments)

4.2.10 HEOs

4.2.11 Graphic Arts Material

4.3 Control Room Inventory

4.3.1 Correspondence

4.3.2 Team Meetings and Conference Minutes

4.3.3 Telecons

4.3.4 Guidelines and Procedures

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4.3.5 Forms

4.3.6 Completed Forms

4.3.7 Control Room Inventory Results and Printouts

4.3.8 Evaluations, Summaries or Reports (Each Major Draft with Review Comments)

4.3.9 Graphic Arts Material

4.4 Control Room Survey

4.4.1 Correspondence

4.4.2 Team Meeting and Conference Minutes

4.4.3 Telecons

4.4.4 Criteria Report (Each Major Draft with Review Comments)

4.4.5 Checklist Forms

4.4.6 Checklist (each Major Draft with Review Comments)

4.4.7 Completed Checklist Work Sheets (Raw, Data with Support Sketches, Photos etc.)

4.4.7.1 Work Space

4.4.7.2 Communications

4.4.7.3 Annunciator

4.4.7.4 Controls

4.4.7.5 Visual Displays

4.4.7.6 Labels and Location Aids

4.4.7.7 Process Computer

4.4.7.8 Panel Layout

4.4.7.9 Control-Display Integration

4.4.7.10 Control Room Equipment and Storage

4.4.8 Evaluations, Summaries and Reports (Each Major Draft with Review Comments)

4.4.9 CRS - HEOs

4.4.10 Graphic Arts Material

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vaxc/#97

5.0 HEO ASSESSMENT AND HED IMPROVEMENT

- 5.1 Assessments and Improvement Reviews
  - 5.1.1 Correspondence
  - 5.1.2 Assessment Team Meetings Minutes
  - 5.1.3 Telecons
  - 5.1.4 Guidelines and Procedures
  - 5.1.5 Forms
  - 5.1.6 Completed Forms
  - 5.1.7 Results and Computer Compilations (HEOs/HEDs)
  - 5.1.8 Submittals to Management and Replys
  - 5.1.9 Evaluations, Summaries or Reports (Each Major Draft with Review Comments)
  - 5.1.10 Graphic Arts Materials
- 5.2 Improvements Implementation (Human Factors Related)
  - 5.2.1 Correspondence
  - 5.2.2 Meeting Minutes
  - 5.2.3 Telecons
  - 5.2.4 Guidelines and Procedures
  - 5.2.5 Work Effort Results
  - 5.2.6 Evaluations, Summaries or Reports (Each Major Draft with Review Comments)
  - 5.2.7 Graphic Arts Material

6.0 NRC MEETINGS AND AUDITS

7.0 SPECIAL STUDIES

8.0 DOCUMENTATION

8.1 Final Report

8.1.1 Correspondence

8.1.2 Meeting Minutes

8.1.3 Telecons

8.1.4 Guidelines and Procedures

8.1.5 Reports (Each Major Draft with Review Comments)

8.1.6 Graphic Arts Material